CHAPTER 1

Introduction

Constitution of the Special Review

1. On the 3/4 June 1967 two accidents occurred to United Kingdom registered public transport aircraft. These accidents took place within a few hours of one another and both involved older aircraft of the DC4 type. Considerable public concern was expressed as to safety standards in general and more particularly the safety aspects of operating older aircraft especially of the DC4 type.

The first accident involved an Air Ferry DC4 aircraft, G-APYK, which hit high ground approaching Perpignan; in accordance with international practice, the accident is being investigated by the French authorities. The second accident occurred to a British Midland Airways Canadair C4 aircraft, G-ALHG, which came down at Stockport whilst approaching Manchester Airport; in this case a public inquiry has been ordered by the Board of Trade.

In addition the President of the Board of Trade ordered this Special Review. Following discussion in the House of Commons on 28 June 1967, Mr. Jay said:

> The causes of accidents vary widely. I wish to make it clear that I have no present grounds for supposing that airline operators in possession of a certificate are not competent to ensure safe operation, that aircraft certified as airworthy are not in fact so, or that licensed aircrew are not competent. Supervision of these matters is a constant process, and my officers are always seeking ways to improvement. But in present circumstances I considered it desirable to ask the statutory authorities to make an even more rigorous scrutiny themselves as to the way in which operators of United Kingdom registered aircraft do in practice meet the requirements.
>
> I believe that the right course at this stage is a thorough review of the operators' performance by the Director of Aviation Safety and the Air Registration Board, as the statutory authorities. Some independent advice will also be desirable, however, and I have decided, therefore, with the ready concurrence of those concerned, to ask two independent advisers, whose names I will announce shortly, to assist them in conducting the review and in drawing up their conclusions. When I have the conclusions, I will make them available to the House; and if then I see need for improving the effectiveness of any of the present arrangements, I will take the necessary action.

Scope of the report

2. It follows therefore that there are two essential elements of this report. First, the results of a special review by the Director of Aviation Safety and the Air Registration Board of the safety performance of the various operators of UK registered public transport aircraft. Secondly, the conclusions drawn from the Special Review and comment on the efficacy of the present arrangements.

3. There are 41 operators of public transport aircraft currently holding Air Operators' Certificates, varying in size from the two Corporations and the larger Independents to small companies operating local pleasure flights.

The statutory authorities

4. Prior to the Civil Aviation (Licensing) Act 1960, together with the Air Navigation (Amendment) Order 1960, there was little effective enforcement of safety legislation outside the airworthiness field. Under Article 3A of the Air Navigation Order 1960, as amended by the above Order (now Article 4 of the Air Navigation Order 1966) no UK registered aircraft over 5000 lb maximum all up weight was permitted to fly for the purpose of public transport except in accordance with an Air Operator's Certificate granted to the operator of the aircraft. Air Operators' Certificates (AOCs) are granted by the Director of Aviation Safety (Article 4(3) of the Air Navigation Order 1966, a consolidating Order).

Before granting such a certificate, the Director of Aviation Safety is required by the Order to be satisfied that the operator is competent to secure the safe operation of aircraft. The Director can suspend, vary or revoke a certificate after one month's notice of intention to take such action unless certain conditions are met, or immediately, provided that he is prepared to certify that it is in the interests of the safety of air navigation.

Under the Civil Aviation (Air Registration Board) Order 1967, the Air Registration Board have had entrusted to them, inter alia, the advisory function of making recommendations to the Director of Aviation Safety as to an operator's competence insofar as the operator's arrangements for the maintenance of his aircraft are concerned.

Procedure followed

5. The present arrangements for granting Air Operators' Certificates are described in chapter 3. These are the normal procedures designed to ensure safety. The review of the operators' performance took the form of an intensification of these procedures, indeed no other way was practicable, and the action taken was as follows :

(*a*) The Director of Aviation Safety made an extensive personal investigation of the reports and correspondence relating to each of the AOC holders and, together with the Chief Inspector of Flight Operations, interviewed each of the Principal Inspectors as well as the officers responsible for standards of pilot licensing and competency. These were searching investigations designed to ensure that the Director was fully informed in detail about each operator and his standards. To supplement these inquiries, the Chief Inspector of Flight Operations instituted an intensive programme of flight inspections along the routes, designed to give as clear an indication as possible of operational standards currently being achieved ; many reports were made and analysed. An increased number of pilot competence checks were observed by the Flight Examiners of the Board of Trade Civil Aviation Flying Unit.

The ARB headquarters staff reviewed, with the Surveyors intimately concerned, the maintenance and overhaul arrangements of each AOC holder. In a large measure this information was available within the ARB records but a specific effort was made to reassess it critically. The current operational commitments and as far as possible the present plans of each operator were established. The effectiveness of the management, the competence of the technical organisation, the facilities and hangarage, and sub-contract arrangements were re-examined in depth.

(*b*) An essential prerequisite of the Review of the operators' safety standards was a general review of accidents which was carried out by the Directorate of *Flight* Safety and the Air Registration Board. This included a detailed analysis of all notifiable accidents to UK registered civil transport aircraft and a statistical study of the safety levels achieved by UK airlines over recent years together with some comparisons with other countries. The results and conclusions are in chapter 4.

(*c*) A number of meetings was held between the statutory authorities and the independent advisers and the latter were kept informed at all stages of the progress of the procedures described above.

(*d*) Written representations were received from Members of Parliament, various organisations, and members of the public, whose names are listed in appendix A. Such representations as are relevant to our terms of reference have been taken into account in the course of the Review.

The Chicago Convention on International Civil Aviation

6. In considering the efficacy of the present arrangements, it is important to differentiate those responsibilities which fall to the State from those which fall to the aircraft operator; these respective responsibilities are clearly defined in the Chicago Convention on International Civil Aviation, Annex 1, "Personnel Licensing", Annex 6 "Operation of Aircraft", and Annex 8, "Airworthiness of Aircraft".

Legislation

7. The legislation relevant to this Review is as follows:

(*a*) *The Civil Aviation Act 1949, Section 8* empowers the making of Orders in Council to give effect to the Chicago Convention and to regulate air navigation; United Kingdom domestic legislation closely follows the internationally agreed standards and recommended practices contained in the Annexes to the Convention.

Section 1 of the Civil Aviation Act charges the Board of Trade with the general duty of "organising, carrying out and encouraging measures for the . . . promotion of safety and efficiency in the use" of civil aircraft.

Section 7 enables the Board of Trade to delegate their administrative functions relating to the design, construction and maintenance of aircraft. The Civil Aviation (Air Registration Board) Order 1967 has been made under this Section and delegates to the Air Registration Board a number of administrative and advisory functions including responsibility for airworthiness and for advising the Director of Aviation Safety as to the competence of an operator having regard to his arrangements for aircraft maintenance.

(*b*) *The Air Navigation Order 1966* and the *Air Navigation (General) Regulations 1966*, cover the main aspects of aircraft operation, including such matters as weather minima, crew composition, flight time limitations, qualifications of aircrew, fuel reserves, instruments and equipment; in this wide field the Order and Regulations must leave a certain amount of the duty to ensure safety to the operators, having regard to the particular circumstances which vary with types of aircraft, routes and meteorological conditions. Examples of this are Article 23 of the Order which lists operators' responsibilities and Article 27 which covers pre-flight action by commanders of aircraft.

(*c*) *The Civil Aviation Licensing Act 1960:* Section 1 required the establishment of a licensing authority to regulate air transport operations and makes reference to the AOC. The Air Operator's Certificate is an indication that the operator measures up to a standard of operational efficiency.

8. In general it can be said that it is the duty of the State to regulate air navigation and it is the responsibility of the operator and the aircraft commander to comply with the statutory requirements and to ensure good operating practice and thereby flight safety. The State, however, has an over-riding responsibility to see that the operator discharges his responsibilities adequately.

CHAPTER 2

Responsibilities of the Aviation Safety Division of the Board of Trade and of the Air Registration Board

Part 1: Responsibilities of the Aviation Safety Division of the Board of Trade

9. The Directorate of Aviation Safety and the Directorate of Flight Safety both report to the Under Secretary, Aviation Safety and General Division.

The Director of Aviation Safety

10. In addition to being the statutory authority for the Air Operator's Certificate, see chapter 3, the Director of Aviation Safety (DSA) is responsible for standards of aircrew licensing and training. In all matters concerning aircraft maintenance and the examination of pilots and flight engineers on their technical knowledge of the aeroplane, the Directorate is advised by the Air Registration Board.

Ab-initio and airline training

11. Standards are laid down for training and examination requirements as well as for flying experience for aircrew. The schools for training, which all ab-initio candidates for the commercial pilot's licence are required to attend, are regularly inspected and approved. The various ground examinations, except those delegated by statute to the Air Registration Board, are conducted by the Directorate's Examiners, whilst flying tests are carried out by the Flight Examiners of the Civil Aviation Flying Unit.

Standards are also set for airline training; companies' type rating and instrument rating examiners are appointed to act on behalf of the Board of Trade and flight simulators are inspected and approved for training and testing purposes.

Weather minima

12. Answering directly to DSA is the Weather Minima Section. This section is responsible for examination of operators' instructions to pilots on weather minima and for giving advice on amendments to their operations manuals. These instructions reflect the conditions in the Regulations. The examination includes evaluation of operators' methods and formulæ for determining weather minima.

Detailed terms of reference of the Directorate are given at appendix B.

The Director of Flight Safety

13. The Director of Flight Safety (DSF) is responsible generally for "operational" and safety legislation. This includes the issuing of certificates of airworthiness for British registered aircraft, in collaboration with the Air Registration Board, and for ensuring by appropriate legislation that aircraft are so crewed and equipped, that they may be safely operated. He is

responsible for co-operation with ICAO on flight safety matters and for planning for the supersonic transport aircraft requirements in these fields.

Aircraft accidents and incidents—follow-up action

14. DSF is also responsible for disseminating information on lessons learned from aircraft accident and incident investigation, and for ensuring that any follow-up action shown to be necessary as the result of these investigations, is taken; the Air Registration Board take follow-up action on mechanical defects. This calls for close co-operation with the ARB and with those concerned (e.g. flight crew and operators) in the industry, as well as with other concerned branches in the Board of Trade. DSF represents the Board of Trade on the Flight Safety Committee. Studies are carried out within the Directorate of special matters which appear to warrant investigation in depth in an attempt to determine what action can usefully be taken. The Directorate is also represented in the team of doctors which is carrying out a special study of flight deck workload and performance.

Detailed terms of reference of the Directorate are given at appendix C.

15. The above reference to the functions of the Air Registration Board is expanded in part II of this chapter.

Part II: Responsibilities of the Air Registration Board

16. The ARB was formed in 1937 in order to undertake duties delegated to it by the government department responsible for civil aviation.

It is composed of a Council of 18 members representing all interests in British civil aviation and a permanent staff of approximately 340. This includes 184 technical staff, of which 106 (90 UK, 16 overseas) are qualified survey staff. The AOC commitment is directly controlled by three surveyors who are supported by survey staff of the 12 UK area offices and specialist staff as required from the head office at Redhill, Surrey.

ARB duties

17. Current legislation (The Civil Aviation (Air Registration Board) Order 1967) delegates to the ARB certain administrative functions of the Board of Trade. The ARB is responsible for formulating and publishing the British airworthiness code and ensuring that this code satisfies the minimum standards laid down by ICAO. Broadly ARB duties include the airworthiness control of the design and construction, performance and maintenance in service of all civil aircraft on the United Kingdom register. In addition and by specific contracts ARB overseas offices have been established in various parts of the world to provide a service to local governments similar to those undertaken on behalf of the Board of Trade.

Detailed terms of reference are given at appendix D.

ARB procedures

18. (i) *Design and performance*

The ARB prepares and issues *British Civil Airworthiness Requirements* which stipulate the minimum design standards which must be achieved. These standards apply to the aircraft as a whole and to its component parts, such as engines and items of equipment. The design standards include not only direct design criteria but also tests to be carried out and conditions to be met when establishing the performance of an aircraft and its components.

It is for the design organisation to prove to the satisfaction of ARB that the design standards are met. Suitable organisations, invariably a department or division of a constructing company, are approved for this purpose so that responsibility for much of the detailed proof of compliance is delegated, but the ARB conducts extensive and sufficiently detailed investigations to assure itself that the organisation's airworthiness investigation is adequate.

(ii) *Construction*

The fabrication of materials and the construction of aircraft including components and items of equipment must be undertaken by companies approved for the purpose by ARB; the inspection of such work is supervised by ARB and the ultimate standards agreed.

(iii) *Manuals*

In addition to the foregoing procedures the ARB requires constructors to prepare manuals to assist the operators/overhaulers in their subsequent maintenance, overhaul and repair of the equipment.

Each aircraft's flying limitations, handling qualities, schedules of performance and essential drills, are published by ARB in a flight manual.

(iv) *Maintenance schedules*

The standards of maintenance of aircraft and associated airborne equipment are established by means of a maintenance schedule. This schedule is prepared by the operator of the aircraft with the assistance of the appropriate manufacturers and, when satisfactory, approved by the ARB. The schedule defines the amount of servicing, inspection and overhaul required and the elapsed periods of flight and calendar time when such work shall be accomplished. It is essentially a programme of inspection which is divided into checks, periods or blocks which must be satisfactorily completed at established flight or calendar times in the life of the aircraft.

(v) *Maintenance work and inspection*

The maintenance and overhaul work including inspection is carried out by companies approved for overhaul or engineers licensed for maintenance by ARB. The inspections carried out are supervised and the standards achieved are monitored, in each case by ARB staff.

19. The Air Operator's Certificate procedure followed by the ARB is described in chapter 3.

CHAPTER 3

The Air Operator's Certificate: History and Procedures

Part I: Brief History of the Air Operator's Certificate and Explanation of Procedures

Early method of supervision of public transport operations

20. The supervision of public transport operations originated in 1948, on instructions from the Parliamentary Secretary of the day, in the form of simple pre-flight inspections by aerodrome staffs not necessarily having any operational training or background. It soon became apparent that these arrangements were inadequate and a system of limited post-flight document inspections by Divisional staffs was introduced, with the object of ensuring that operators interpreted regulations properly and operated to sound standards. Shortly afterwards, the first of the Associate Agreement services came into operation, and the Department made this an opportunity to take the first steps in approving operational standards and exercising much closer supervision of operations than had hitherto been envisaged.

21. The volume and scope of the work was increasing steadily of course with the growth and development of the industry. Operators had increased in size and number, aircraft in weight, range and complexity, legislation had become more comprehensive and detailed and to the amount of work on Associate Agreement services was added an additional commitment in regard to trooping contracts. The supervisory procedure that had been evolved in respect of operators running scheduled services was to select at random, on the occasion of what were then called "liaison visits", a number of flights made during the preceding two or three months; normally at least two scheduled journeys were selected; if the operator's organisation was divided into flights, or should he operate more than one type of aircraft, the flights selected were made suitably representative. The records relating to these flights were then examined in detail, so that load and trim, weight and performance, crew licensing, flight planning, flight time limitations etc. were covered.

22. Nevertheless, these paper inspections alone could give no firm assurance of what was being achieved in practice but merely indicated a theoretical standard, the exception being the in-flight inspections that were being carried out, on behalf of the Air Ministry, on operators carrying troops under contract to Service Departments. What this virtually adds up to is that until about 1959, successive Departments responsible for civil aviation took the line that where legislation placed responsibilities on the operator of an aircraft the fulfilment of these responsibilities was largely a function of management, and not the concern of the Department.

23. A public inquiry into a particular accident which occurred in 1958 revealed that the operating and maintenance standards of the airline involved

left much to be desired. It was becoming increasingly evident that the only way in which the Department could meet its own responsibilities in regard to aviation safety was to examine every operational aspect of public transport flying; in other words, to back the paper inspections with observations of the operators' actual standards of operation as defined in the operations manual and demonstrated in flight.

Introduction of the Air Operator's Certificate

24. In order to translate this conclusion into practice, it was decided to establish new machinery which would provide the Minister with more positive control over operators. The Air Operator's Certificate was introduced and the Flight Operations Inspectorate established under the Chief Inspector of Flight Operations. Responsibility for investigating the adequacy of an operator's arrangements for aircraft maintenance was fully delegated to the Air Registration Board, whose advice and recommendations to the Director of Aviation Safety are accepted without question.

The Flight Operations Inspectorate

25. With the exception of the maintenance arrangements, an operator's competence and facilities are investigated on behalf of the Director by the Department's Flight Operations and Training Inspectors. CA form 1238, *Air Operators Certificates—Information for Applicants and Holders*, sets out the operational requirements for the issue and continuance of the certificate. After the certificate is granted, operators are supervised more or less continuously in accordance with the Inspecting Staff Manual. The examination of the specific weather minima is carried out by Flight Operations Inspectors who check the actual figures against a "Guide on Weather Minima" prepared by the Directorate's weather minima section.

26. A series of routine checks and inspections are carried out with each operator so as to cover progressively every aspect of the organisation. Reports are submitted to a Principal Inspector on each check, and matters of particular importance are referred to the Chief Inspector and the Director as necessary. Principal Inspectors are in any case required to make a review of reports and correspondence once a year and to make their own routine report to the Chief Inspector. Details of the nature and scope of the routine checks are given in appendix E.

27. The Flight Operations Inspectorate is staffed by carefully selected people having wide recent experience as airline pilots, many as operations managers or chief pilots; they work under the Chief Inspector of Flight Operations who is himself an experienced pilot holding a current airline transport pilot's licence, and who reports directly to the Director of Aviation Safety.

The Civil Aviation Flying Unit

28. Standards of operators' training and testing are observed by the Flight Examiners of the Board of Trade's Civil Aviation Flying Unit who are appointed as Training Inspectors for this purpose. This Unit does not, however, come under the direct control of the Director of Aviation Safety; furthermore it has other tasks and these inhibit the training inspection programme. These other tasks include the checking of all UK radio and

radar aids to navigation and approach to landing and as stated earlier the *ab initio* testing of every pilot for his commercial pilot's licence and instrument rating, tests which are not delegated.

29. This division of responsibility, between the Flight Operations Inspectors and the Flight Examiners, stems from a decision taken at the time of the introduction of the Air Operator's Certificate. For many years, pilot competency and type rating checks had been conducted by check captains employed by operators and authorised by the Minister. There was already established a limited system of training inspection. Flight Examiners from CAFU were at that time already conducting flight inspections of operators' Instrument Rating Examiners and had experience, albeit limited, in this role. It was decided to continue this existing and acceptable system of flight supervision of examiners and that authorised examiners should continue to conduct tests and make their decisions in accordance with the authority delegated to them. But to strengthen the system a percentage of the tests carried out would however be observed to ensure that the conduct of the tests was satisfactory. For this purpose the Flight Examiners, all experienced instructors and examiners, were given type training on the airline aircraft to which they were allocated. Their task, acting as training inspectors, has not been to test the authorised examiners, but to observe and report upon the conduct and standards of tests applied by operators' own check pilots Certain tests may be carried out on flight simulators approved by the Department. In the event of there being a query about the conduct or outcome of any test the matter is referred to the Director.

The Aircrew Training Branch

30. The aircrew training branch (SA(L)4) is responsible, in consultation with all concerned, for developing policy on general rules for the conduct and supervision of airline training, including standards of tests for the appointment and supervision of examiners nominated within companies for licensing purposes, and for flight simulator policy.

31. Implementation of policy, approval of the syllabi of conversion training and refresher training, and the examination of records to see that training is carried out is the responsibility of the individual Flight Operations Inspector assigned to a company.

The Air Registration Board

32. The Air Registration Board has survey staff established in twelve area offices in the United Kingdom. Each office is controlled by a Surveyor-in-Charge who is directly responsible to the Chief Surveyors. These area offices are responsible for routine work in the area associated with the issue and renewal of Certificates of Airworthiness, the approval and supervision of firms, and the examination of licensed engineers.

33. The responsibility for investigating operators' maintenance arrangements was delegated to the ARB when the Air Operator's Certificate was introduced.

The ARB subsequently published minimum general standards (Chapter A6-4 *BCARs*) which it would require of operators' maintenance organisations prior to recommendation for the issue or renewal of an AOC. At the same time a small team of Surveyors was established to specialise in the implementation of these AOC maintenance standards. This team operates under the direct control of the Chief Surveyors who forward Board of Trade requests for recommendations with appropriate instructions to the team and in due course advise the Board of Trade of the ARB recommendations.

34. Whereas the ARB's normal survey work associated with the issue and renewal of Certificates of Airworthiness is primarily concerned with the airworthiness standards of aircraft, the AOC team's work is planned to monitor the maintenance procedures established by the operator to ensure that his aircraft achieve the minimum airworthiness standards required. This involves detailed examination of operators' base maintenance facilities, personnel training programmes, control of route stations, and defect rectification procedures. In this work the team are able to call on other departments of ARB for assistance—for example the Maintenance Schedule department which is responsible for the approval of all maintenance schedules; the Radio department, responsible for approval of radio communications and navigation stations; the Specialist department, responsible for inspection standards of instruments, electrical and electronic equipment.

35. Initial surveys of a new operator's facilities or his contracted maintenance facilities are made by the team in conjunction with the Surveyor-in-Charge of the area in which the maintenance facilities are established. Reports are made on *pro formas* which are designed to cover every aspect of the facility. These initial approvals usually involve a series of visits by the AOC team, each lasting a number of days. Subsequent supervision is planned at six-monthly intervals but significant variations in the operator's commitments, changes in the senior technical staff and/or changes in the aircraft fleet involve additional visits followed by reports from the AOC team leader to the Chief Surveyors.

Any significant failure to maintain acceptable standards of maintenance is reported to the Board of Trade and can result in suspension of the operator's certificate.

Part II: Implementation of Procedures

Safety level of the independent operators

36. As will be seen from chapter 4, although the safety records of both the combined Corporations and the Independents have improved over the past ten years, the safety level of the Independents in each five-year period and in the whole ten-year period was significantly lower than that of the combined Corporations. Each operator has been certified as "competent to secure the safe operation of aircraft" after investigations based on CA form 1238 and the *Inspecting Staff Manual* (ISM); this has entailed positive recommendation from the Inspectors and should have secured better results in respect of the Independents.

37. Why were better results not achieved? First it must be borne in mind that it is not always possible to look at any single accident and say that a particular measure would have prevented it; but there is no doubt that with a careful watch on all aspects of aircraft operations the chances of an accident happening is greatly reduced and the probability of an improvement in the air safety record thereby enhanced.

38. For six years Board of Trade Inspectors have examined and investigated operators according to the yardsticks prescribed (which are accepted as being adequate) and to the full extent that the numbers of staff permitted. Some operators have failed to measure up and have either been kept out of business or their Air Operators' Certificates withdrawn. In other cases however operators' standards have been considered satisfactory and yet they have had accidents. Evidently there has been something missing either from the basis of assessment or the routine supervision, or both.

39. Setting aside the "maintenance" or airworthiness accidents there are a number that can be ascribed to operational reasons—faulty operational management—either on the flight deck or in the operations department. Usually it is both because the former is largely a reflection of the latter; flight deck management stems from the general operational environment which the operational management creates. Flight deck management stems also from proper disciplines and disciplines in any environment stem from training standards vigorously and relentlessly applied.

40. It may well be that the vital element missing from the basic assessments and routine supervision has been effective control of the operational management and of training standards and the question is why has the inspectorate not been sufficiently effective in those spheres. One reason could be that the importance of these factors was not appreciated and therefore that it was not receiving proper attention, but this is not so; both the Director of Aviation Safety and the Chief Flight Operations Inspector have been fully aware of the need and the shortcomings of the machinery but so far have not had the resources to take fully effective measures.

Staffing problems of the Directorate of Aviation Safety

41. The reasons for this should be reviewed against the following significant factors:

(*a*) Treasury have always been sceptical of the needs of the Inspectorate. In 1963 when they were asked for two more Head of Section posts they reluctantly agreed to one more post after sending one of their own staff to investigate. Nevertheless the need for this second post was subsequently demonstrated on many occasions, and was belatedly recognised.

(*b*) The financial climate of recent years has meant that the arguments for a proper complement of Flight Operations Inspectors have had to be put forward at the very time when all Ministers have been under pressure from the Chancellor of the Exchequer to review their staffing costs, even to the extent of deferring or cancelling schemes which entail staff increases.

(*c*) There could be no lowering of standards of the Flight Operations Inspectorate. Captains of public transport aircraft justifiably expect the Board of Trade to provide Inspectors with an equivalent background of flying experience and who are up to date with current operational problems. The skill, integrity and insight of the approving organisation is crucial and without the right calibre of inspector the AOC would be of little worth.

Taken together or separately, these factors have resulted in the Inspectorate having an inadequate number of staff to meet requirements. A table comparing staff strengths and staff complements is at appendix B (ii).

Situations have arisen where it has been suspected that all is not well with an operator but there has been inadequate effort to do a proper investigation without neglect in other critical areas; and suspension or variation of an Air Operator's Certificate would not stand up to appeal unless it were based on full investigation.

42. Since the introduction of the Air Operator's Certificate, the situation has been as follows:

(*a*) It was not until comparatively recently that it was accepted that a Chief Inspector of Flight Operations having the essential qualifications and experience should be appointed.

(*b*) The Inspectorate has been consistently short of staff; only during the last few months has the effective number of Inspectors risen above half the complement that Treasury now accept is necessary. This has been due primarily to failure to pay the rate for the job; salaries were hoisted only following the resignation of five well-qualified men within a month, men on whom the Department had spent many thousands of pounds in training.

For similar reasons, the Civil Aviation Flying Unit has never been up to complement, with the result that the Flight Examiners have been unable to observe a sufficient number of pilot competency checks being carried out.

(*c*) The British Airline Pilots Association in particular have had to be conditioned to accepting even the limited amount of "flight deck" work that the Inspectorate has been able to do.

(*d*) Over the years, far too much of the time of the Director of Aviation Safety and the Chief Inspector has been consumed in arguing the case for adequate staff and pay.

43. In brief, the recurring problem has been insufficient staff of the right calibre throughout the period that the Air Operator's Certificate has been in force. It is unfortunate that Treasury were not earlier persuaded of the merits of the arguments put to them in respect of both salary and complement. Had they been persuaded, it would have been possible a lot earlier to give full attention to the day by day, month by month, implementation of standards by management and in particular to pilot training and checking. Furthermore, considerable economies would have been effected in the costs of training and type conversion of both Flight Operations Inspectors and Flight Examiners.

Steps must be taken to ensure that in future pilots on whom large sums are spent on this essential training are not easily attracted to employment elsewhere. This can only be done if the salary and conditions of service compete adequately with that attaching to equivalent positions in the aviation industry. Apart from the loss to the Department's safety effort, a loss moreover that cannot be made good in much less than twelve months, it is wasteful to spend many thousands of pounds on a pilot for training and conversion only to lose his services as soon as he possesses the necessary qualifications, because the terms of employment are inadequate to hold him in the service of the Department.

Pilot competency checks

44. On this question of pilot competency there was recently considerable comment in the press about pilots being checked by the company's own examiners. In considering this practice it is essential to have in mind the responsibilities of the State and those of the operator.

Pilots engaged on public transport flying are required to hold professional pilots' licences appropriate to the weight of the aircraft they fly and endorsed for the particular type, and also to hold an instrument rating. These qualifications and the pilots' continued competence to hold them are the responsibility of the State. All initial tests for the licence and the instrument rating are conducted by the Department's examiners. Tests for subsequent type rating and for the renewal of the instrument rating are carried out by selected operators' pilots authorised by the Board of Trade.

45. With regard to the operator's responsibilities, Annex 6 to the Chicago Convention, chapter 3, paragraph 3.2 states:

> An operator shall ensure that each of his pilots is familiar with the regulations and procedures pertinent to the performance of his duties prescribed for the areas to be traversed, the aerodromes to be used and the air navigation facilities relating thereto. The operator shall ensure that other members of the flight crew are familiar with such of these regulations and procedures as are pertinent to the performance of their respective duties in the operation of the aeroplane.

and chapter 4, Flight Operations, paragraph 4.2.2:

> An operator shall ensure that all operations personnel are properly instructed regarding their particular duties and responsibilities and the relationship of such duties to the operation as a whole.

46. As mentioned above, these international requirements are reflected in United Kingdom legislation, for example Article 23(2) of the Air Navigation Order 1966 requires the operator to satisfy himself that a pilot " . . . . . . is competent to perform his duties and in particular to use the equipment provided in the aircraft for that purpose."

47. It is therefore the responsibility of the operator to appoint suitably qualified and experienced pilots to conduct the training and testing of his pilots ; it is also the responsibility of the State to see this is properly done. Since the flying of the particular type of aircraft on instruments forms an essential part of a pilot's skills, the Department encourages the building of the instrument rating and the type rating tests into the competency checks, and there are considerable advantages in the operator's check pilots holding the authority of the Board of Trade to conduct instrument rating and type rating tests. Competent check pilots must essentially be in constant practice on the aircraft ; they must be thoroughly conversant with the equipment used by the company, the route structure, the company's operations, flight and training manuals relating to the aircraft on which the checks are to be carried out. The present system meets these requirements.

48. If, however, there was evidence that this system was being abused, there are only two other ways of checking pilots, neither of them very practicable due to the sheer magnitude of the task. One would be for the Department's Flight Examiners to conduct all tests, the other for a panel of company examiners to be set up, no examiner being called on to test pilots employed by the same company as himself. In the past both of these systems have been examined, and discarded. In either case the practical advantages mentioned above would be to a large extent lost.

49. Existing legislation calls for periodic competency checks both ground and air for each type of aircraft currently flown and an instrument rating test. There is also of course the initial type rating test for each additional type a pilot may require on his licence. It is estimated that there are approximately *3650* pilots engaged on public transport duties giving rise to a requirement for something like:

7300 competency check flights at base ;
3600 instrument renewal flight tests, and
1100 type rating flight tests for initial qualification on new types.

Allowing for the growing practice of combining instrument rating renewal tests with competency flights mentioned above, the total requirement amounts to some 8,400 tests per year. These checks are spaced over about 40 AOC holders using some 30 different types of aircraft.

50. For the Department to conduct all these tests would require many more pilots than the existing establishment of Flight Examiners, all of whom would have to be paid airline rates of pay, as well as a very costly training programme either with the operators of the various types of aircraft or by the Department maintaining its own large fleet including each type of aircraft; but in this case the examiners could not be as experienced on the aircraft as experienced airline pilots.

51. The other alternative, a panel of company examiners, would present a formidable administrative problem. Consideration of the numbers of examiners that would be needed immediately shows its complexity. Amongst many factors which would affect the situation would be:

(*a*) the need for regular training of examiners in other companies' procedures ;
(*b*) the need for examiners to be available to other companies at short notice and at other aerodromes ;
(*c*) the extent to which check pilots employed on normal line duties could be made available for examining work.

It would be necessary to set up a control agency to co-ordinate bookings, arrange payment of fees and charges for special training.

52. When all this had been done (if it could be done) there is little doubt that standards of checking would fall for in spite of refresher training, examiners could never be thoroughly conversant with other companies' practices and equipment.

53. To return now to the implications of the present system. Is it open to abuse? Of course it is. Although the majority of check pilots are men of integrity and realise full well the vital nature of the task that they carry out,

the fact remains that commercial pressures and misguided loyalties could influence decisions and certain safeguards are employed; current practice is as follows:

(i) to require the operator to produce a training manual and approve the training and testing syllabi laid down therein;

(ii) to examine the records of training carried out by company check pilots to ensure that the content and standard of training and testing is properly carried out;

(iii) to observe periodically company check pilots conducting flight tests on other pilots employed by the company.

54. But as has been mentioned above the Civil Aviation Flying Unit has for some time been at little more than half strength and the sample of flight tests observed has been considerably lower than planned although in general the checks observed have been competently conducted. What was, however, illustrated in the course of the Review in the case of one operator is that occasional sampling of a check captain's work will not necessarily indicate his normal standard or that of the company. What is required is the observation of a series of tests sufficient to reveal whether there is any significant difference in the company's check captains pass/fail rate when under observation.

The Air Transport Licensing Board

55. The duty of the Air Transport Licensing Board, under subsection 2(2)a of the Act is to consider whether they are satisfied that the financial resources of the applicant for a licence are sufficient "for the purpose for which he seeks an air service licence". At the same time, the Board are, under subsection 2(4) precluded from considering matters for which an Air Operator's Certificate is required, that is the operational competence of the applicant. There are, in the reports of the Board, a number of comments on the financial resources of airlines, the latest being paragraphs 107 and 108 of the *Sixth Report*,* which read:

> 107. In the same period we considered applications from six companies which had not previously held air service licences, and we granted licences to four of them. We take this opportunity to remark that new applicants particularly must provide us with clear and satisfactory evidence of their financial resources and competence. One such applicant during the last year was unable to tell us even how his share capital was constituted; he succeeded merely in wasting his own time and ours.
>
> 108. This criticism does not apply only to newcomers to the industry. There are still some established companies from whom it is difficult to obtain a clear picture of their capital structure and resources.

and earlier, in the same report, paragraph 15 opens with saying "The urgent need for re-equipment in order to provide the kind of service that the public and the national interest demand is one that the industry cannot ignore." Not only is the cost of such re-equipment high but so also is the cost of the proper training of pilots to fly these modern aircraft.

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* Session 1966-67, HC 96 (HMSO, 4s. 6d.).

56. Article 4 of the Air Navigation Order 1966 does not give the Director of Aviation Safety powers to refuse an Air Operator's Certificate on grounds of any doubts he may have about an applicant's financial stability; and there have been such cases.

Airworthiness aspects

57. Present legislation permits individual technical engineers to take full personal responsibility for the maintenance standards achieved on individual aircraft. Under this system the ARB has relatively little control of the standards under which an engineer elects to work. It can merely take action subsequent to a proven failure by the engineer concerned. The alternative system of prior ARB approval of a complete organisation, which legislation already provides for in the construction and overhaul fields, should be enforced by appropriate legislation. It is unrealistic to expect an individual and possibly junior engineer to take full responsibility for the airworthiness state of a complex aircraft at any one time.

58. Recommendations for AOC approval are at present based on the operator's own or sub-contracted maintenance facilities; the operator's maintenance commitments relative to his anticipated fleet utilisation are not taken into account. Surveys of maintenance facilities should include a review of the anticipated utilisation. Thus the ARB should examine the possibility of publishing a detailed code of practices which would establish requirements for minimum staff and facilities in an operator's organisation.

59. When the AOC was introduced no separate provision was made to meet the costs of the ARB investigation and supervision. The effect of relying on existing revenue has been to restrict the amount of ARB supervision, particularly overseas.

A recent agreement between the Board of Trade and the ARB to assist with costs of this work should lead to improvement of the standards of maintenance by holders of Air Operators' Certificates.

60. The majority of scheduled maintenance and overhaul is carried out during normal working hours and can thus be adequately supervised by ARB. Non-scheduled maintenance, defect rectification and unscheduled component changes frequently involve the operator in work outside normal hours and/or away from base. Although there is no evidence that this work is the cause of accidents or incidents, the standards applied are often lower than normal. The AOC team's work should, therefore, be reviewed in order to provide supervision of operators at week-ends and at route stations in the United Kingdom and abroad.

CHAPTER 4

Review of Accidents

Measurement of safety levels

61. The only quantitative measures of safety performance in aircraft operations are to be found in the accident and incident records. Detailed records are maintained of accidents that are notified to the Board of Trade in accordance with the Civil Aviation (Investigation of Accidents) Regulations 1951. These Regulations require an accident to be notified:

> ". . . if, between the time when any person boards an aircraft with the intention of flight and such time as all persons have disembarked therefrom
>
> (a) any person suffers death or serious injury while in or upon the aircraft or by direct contact with the aircraft or anything attached thereto;
>
> or
>
> (b) the aircraft receives substantial damage."

62. Accidents that do not fall into these categories do not, at present, require notification. Some of the occurrences (commonly known as "incidents") are brought to the notice of the Department on a voluntary basis by the airline or airport authorities but many are not. In many cases the information volunteered is considered to be "confidential" (in the sense of commercial-in confidence) by the airline concerned and it can only be used for accident prevention purposes after an elaborate process of disidentification. These occurrences have therefore not been included in the present review and the effect of this limitation on the amount of information on accidents available for review is dealt with later in this chapter.

63. The review was carried out in two stages. The first stage was a detailed analysis of all "notifiable" accidents that have occurred to United Kingdom civil transport aircraft since 1955 and the results are contained in appendix F. The second consisted of a statistical study of the accident records of United Kingdom airlines over recent years together with some comparisons with foreign countries and the results are in appendix G. The object of the analysis was to uncover long term patterns, trends or recurring factors in accidents and to relate them to broad classes of operators and aircraft. The object of the statistical study was to cross-check the results of the analysis so far as United Kingdom operators were concerned, to throw light on the rise or fall of United Kingdom levels of safety over recent years and to show these levels in their correct international perspective.

Analysis of accidents from 1955 to 1967

64. The analysis was carried out by teams from the Board of Trade and the Air Registration Board and the findings are described in appendix F

for all aspects except those relating to the effects of age on aircraft. (These are described in chapter 5 and appendix J.) The main conclusions are:

(i) lack of competence on the part of the pilot-in-command was considered to be a factor in about a third of the accidents.

(ii) other deficiencies on the part of pilots (poor judgment, lack of discipline, inadequate crew co-ordination) were considered to be factors in almost a quarter of the accidents.

(iii) airworthiness deficiencies (mechanical defects, maintenance deficiencies and design deficiencies) were considered to be factors in almost a third of the accidents.

(iv) aerodrome deficiencies were contributory factors in 20 accidents but analysis revealed no clear patterns or significantly recurring features.

(v) the record of the Independent operators was inferior to that of the Air Corporations so far as casual factors involving shortcomings of the flight crew, the airline and airworthiness were concerned.

(vi) a small but significant number of pilots had been involved in two accidents in which their competence, discipline or judgment was in doubt.

65. The analysis was confined to a total of 224 notifiable accidents. Other accidents (commonly called incidents) that occurred during the 12½ year period were not reviewed for the reasons mentioned earlier. It is difficult to estimate the numbers of incidents thus omitted from consideration but experience in Australia, where all accidents and incidents are notifiable, indicates that the total number of events occurring in the period was probably of the order of 10 times the number notified under the present United Kingdom legislation. It is therefore possible that some significant trends, patterns and recurring factors over the period have not been uncovered by the analysis and that those discovered have not been properly emphasised. It is clear that information on all accidents and incidents is needed for accident prevention purposes and it is proposed that steps should be taken to make it available on the lines set out in paragraph 82 and appendix H.

The safety performance of United Kingdom operators

66. The statistical study of notifiable accidents carried out in the second stage of the review was conducted by the same teams from the Board of Trade and the Air Registration Board. The study is described in detail in appendix G. It should be noted that the statistics shown on the tables in the appendix relate to notifiable (including fatal) accidents only. The overall picture they present is therefore incomplete because of the lack of statistical information on incidents. Conclusions drawn from the tables may therefore be affected in the same way as those drawn from the analysis of accidents dealt with in paragraph 64, and these considerations further support the proposal in paragraph 65 to make information on incidents available for analysis.

67. Table 1 shows notifiable accidents and operating statistics for the air corporations separately and together, for independent operators together and for all United Kingdom operators together for a 10-year period (mid-1957

to mid-1967). Table 2 shows similar information for two 5-year periods (mid-1956 to mid-1962 and mid-1962 to mid-1967). Accident rates for both notifiable and fatal accidents relating the accidents to aircraft miles flown, aircraft hours flown and to stage flights are given in columns H to M. In addition the numbers of passengers killed in the various periods, the passenger miles flown and passengers killed related to passenger miles flown are shown in columns G, D and N.

68. The relative value of the seven accident rates for comparing airline safety levels is discussed in appendix G. Judgments of comparative levels of safety based on accident rates for different airlines should be made with caution since like is not being compared with like. Where the patterns of operations are similar the most significant rate is probably that relating notifiable accidents to stage flights (column L) since most accidents occur on landing or take off. But where operations are dissimilar (e.g. long haul and short haul) comparisons on the basis of this rate alone are insufficient and the rates based on hours or miles flown must be considered as well. Account should be taken of the severity of notifiable accidents. An indication of the rate of serious accidents is given by the figures in parentheses in column L of tables 1 and 2 of appendix G and by the fatal accident rates in column M.

69. Fortunately the number of fatal accidents to UK aircraft is small and a single accident can have a marked effect on statistics which include fatality as an element. Thus the rate of passengers killed related to passenger miles shown in column N in table 1 is limited in value for purposes of comparing the safety level of airlines. Nevertheless, it is accepted and used internationally and reflects the "public interest" view of the safety level of an airline from the point of view of a prospective passenger. It is considered that, although the rate of notifiable accidents per 100,000 stage flights (column L) gives the soundest comparison of safety levels between companies when their operations are similar (see appendix G), all seven rates shown in the tables should be considered together if a balanced conclusion is to be reached.

70. Applying these considerations to the statistical picture presented for United Kingdom operators on table 1 of appendix G it will be seen that, for the 10-year period, the accident rates of the independent operators in columns H to N are all higher than those of the combined Corporations and in a number of cases the differences are statistically significant. Consequently it is reasonable to assume that their safety levels were lower than those of the Corporations. In most cases the rates are considerably higher although in the case of accidents per 100,000 stage flights the Independent rate is only about 16 per cent. higher than that of the combined Corporations. A similar picture emerges when comparing the Corporations separately with Independent operators except that the rate for notifiable accidents/stage flights for BOAC is higher than that of the Independents. However, BOAC flew a relatively small number of stage flights as compared with the independent airlines during this period and account should be taken of the fatal accidents and the fatal rates and also of the rates in terms of hours and miles flown and passengers killed. In all these cases BOAC's rates are considerably lower than those of the independent operators.

71. Table 2 shows the same data divided into two 5-year periods. The accident rates of all operators were lower in the second period except for the fatal accident rates of BOAC, who had no fatalities in the first period, and a small increase in notifiable accidents per 100,000 stage flights by the Independents.

It can also be concluded that the safety levels of the Independent operators in each period, as in the whole period, were significantly lower than those of the combined Corporations.

International comparisons

72. For the reasons explained in appendix G it is even more difficult to make valid statistical comparisons of airline safety levels internationally than it is to make valid comparisons between United Kingdom airlines. The operating statistics for United Kingdom airlines shown in tables 1 and 2 relate to all public transport operations with aircraft weighing more than 5,000 lb. i.e. those operations for which possession of an Air Operator's Certificate is necessary. Statistics for other countries are not available in such detail. Official operating statistics for the airlines of most foreign countries are available only for those companies which operate scheduled services and in some cases (e.g. the United States) exclude even the scheduled operations of some domestic airlines.

73. The operating statistics published by ICAO for its combined members are similarly limited and reflect the same inconsistencies. ICAO data moreover are limited to fatal accidents which do not, by themselves, provide a satisfactory basis for the comparison of safety levels as explained in appendix G. A further difficulty is that different countries interpret differently the ICAO definition of "notifiable accident" and some countries (e.g. France and Australia) apply the definition in a way that excludes from their statistics some types of accident that are included in those of the United Kingdom. For these reasons it is not possible to draw firm conclusions from the comparative accident rates for scheduled service operations of United Kingdom airlines and those of the selected foreign countries shown on table 3 of appendix G. It may, however, be concluded generally that the safety levels for scheduled services in the United Kingdom are probably lower than in the United States because all seven accident rates for the United Kingdom are higher than those shown for the United States and because the rate for notifiable accidents per 100,000 stage flights shown in column L is significantly higher. It should be remembered however that the rates for the two countries are not on the same basis since it is not known, nor is it possible to estimate, how far the inclusion of all operating and accident data for all United States scheduled services might alter the picture.

74. The information available indicates that United Kingdom levels of safety for scheduled services are lower than those of Australia because United Kingdom rates are higher than Australian rates in all cases. However, no firm conclusions have been drawn from the data since it is the practice in Australia to exclude from notification certain types of minor accident which are notified in the United Kingdom and included in United Kingdom statistics for notifiable accidents.

75. It is not considered possible to draw any valid conclusions from table 3 for the accident rates presented for France. Official French information relates only to the scheduled services of three major airlines. In the United Kingdom many smaller airlines in addition to the major airlines operate scheduled services and their statistics are included in the table. The comparison shown on table 3 so far as United Kingdom and France is concerned is therefore not on a like to like basis. Some indication of the comparative safety levels of the scheduled services of the two countries may however be obtained by comparing the accident rates for BOAC and BEA combined (shown on table 2, line 6) with the French rates for approximately the same period shown on table 3 although the United Kingdom rates include an element in respect of non-scheduled services (because both BOAC and BEA operate some such services) while the French rates do not. Furthermore, as mentioned earlier, French statistics for notifiable accidents exclude some types of accident which are included in the United Kingdom figures. With these reservations it will be seen that the accident rates for the two countries are of the same order and that the slightly lower French figures for the rate for notifiable accidents per 100,000 stage flights may well be accounted for by the different criteria applied in France to the classification of notifiable accidents.

76. A tentative comparison of United Kingdom levels of safety with the levels for the combined ICAO member states prepared from official ICAO statistics is shown on table 3. The comparison is possible only for fatal accident rates since ICAO does not publish current information on notifiable accidents. Fatal accident rates by themselves do not provide a sufficient basis for comparison and we are reluctant to draw conclusions. It may be noted however that the United Kingdom rates, when adjusted to the same basis as the ICAO rates, are below those for the ICAO states except for the rate of passengers killed per 100,000,000 passenger miles where it is 10 per cent. higher.

77. To illustrate the need to look behind the conclusions which might be drawn from table 3, the Air Registration Board has made a supplementary calculation based on the United States records. The bulk of the US scheduled services are conducted by domestic carriers and these show an excellent record of about 1·2 notifiable accidents per 100,000 flights. The US international scheduled services show a rate of 3·5 notifiable accidents per 100,000 flights but as these services constitute a small proportion of the total, the average figure for all scheduled services is small (1·41). The United Kingdom scheduled services, on the other hand, include a high proportion of international flights. Thus the average accident rate might be expected to be, as in fact it is, above the US average.

78. An attempt has been made to compare British and foreign rates of accidents associated with airworthiness. Published data are not suitable for this purpose, due to variations, from country to country, of methods of classification. Therefore, to provide some indication, though not necessarily a very precise one, the Air Registration Board has examined individual records and formed its own judgment in classification. The basis was to count notifiable accidents excluding ones during taxying or standing still on the ground, or where injuries due to turbulence occurred and to count

mixed causes as half-airworthiness/half-operational. On this basis, the following rates per 100,000 flights emerge for the period 1962–66:

United States: Scheduled domestic:	0·3
United States: Scheduled international:	0·65
United States: Non-scheduled domestic:	1·05
Australia: Scheduled:	0·55
France: Scheduled:	0·3

As noted previously, approximately 30 per cent. of UK accidents are attributable to airworthiness causes. Using the same basis of classification as described above, the rates are:

BOAC and BEA:	0·5
UK Independents:	0·95

While reiterating that these figures are not precise measures, it may fairly be concluded that the UK rates are of the same order as comparable foreign operators.

Notification of aircraft accidents and incidents

79. Reference has been made in paragraphs 65 and 66 to the need for making available information on incidents that affect the safety of aircraft. Appendix H reviews the present system for the notification of accidents and the reporting of incidents and makes proposals for its improvement. One of the major obstacles with which the Board of Trade was faced in carrying out the review of accidents was the lack of basic data on which to work. As stated in paragraph 62 there is at present no need for information on aircraft "incidents" to be notified to the Department. This means that many events that may affect the safety of an aircraft are not reported and accordingly no remedial action can be taken. The Accident Investigation Division of ICAO has drawn attention to the importance of obtaining information on incidents for accident prevention purposes. The present policy of the Board of Trade is to encourage airline operators to establish their own machinery for the reporting of such events and to take follow-up action within their own organisations. Some of the information so collected is made known to other airlines through the Government-sponsored Flight Safety Committee. Incidents on which information might not otherwise become available are occasionally revealed by special flight recorders installed in a small number of BOAC and BEA jet aircraft under the Civil Aircraft Airworthiness Data Recording Programme. Results obtained from this source indicate that flight recorders offer a very effective though costly means of accumulating additional information on aircraft incidents.

80. Australian legislation requires both accidents and incidents to be notified. In the US certain specified flight hazards and mechanical defects require notification by law in addition to accidents.

81. Timely information on all occurrences that endanger aircraft offers a valuable guide to methods of preventing more serious accidents, and the present system in this country for collecting and acting on such information should be improved. It relies, to a large extent, on the voluntary exchange of information among some, but not all, airlines and on the follow-up action taken by individual companies. Apart from air misses and bird

strikes, the voluntary system for reporting incidents to the Board of Trade is infrequently used by some operators and the information which is made available by them is often incomplete and out-of-date.

82. It is therefore recommended that steps should be taken to ensure that all occurrences that threaten the safety of any aircraft should be brought to light by operators and used by them for accident prevention purposes. It is also recommended that such incidents should be brought to the attention of the Director of Flight Safety by operators for the purpose of safety analysis.

Conclusions

83. An analysis of accidents that have occurred since 1955 to United Kingdom public transport aircraft has shown that:

(i) lack of competence on the part of the pilot-in-command was considered to be a factor in about a third of the accidents.

(ii) other deficiencies on the part of pilots (poor judgment, lack of discipline, inadequate crew co-ordination) were considered to be factors in almost a quarter of the accidents.

(iii) airworthiness deficiencies (mechanical defects, maintenance deficiencies and design deficiencies) were considered to be factors in almost a third of the accidents.

(iv) aerodrome deficiencies were contributory factors in 20 accidents but analysis revealed no clear patterns or significantly recurring features.

(v) the record of the independent operators was inferior to that of the Air Corporations so far as casual factors involving shortcomings of the flight crew, the airline and airworthiness were concerned.

(vi) a small but significant number of pilots had been involved in two accidents in which their competence, discipline or judgment was in doubt.

84. A statistical study of accident records has shown that:

(i) the safety levels of all United Kingdom public transport operators have improved over the past ten years.

(ii) the safety levels of independent operators as a whole over the ten-year period and in each of the two five-year periods were significantly lower than those of the combined Corporations.

(iii) the safety levels achieved by United Kingdom airlines are probably of the same order as those achieved by the airlines of France and ICAO member states as a whole, but are probably lower than those of United States and Australian airlines.

85. A review has shown that timely information on all occurrences that endanger aircraft is a valuable means of preventing accidents. It is recommended that steps should be taken to ensure that all such incidents are brought to light by operators and used by them for accident prevention purposes. It is also recommended that incidents should be brought to the attention of the Director of Flight Safety by operators, for the purpose of safety analysis.

CHAPTER 5

Examination of the Effects of Age of Aircraft on Safety

Introduction

86. There are two main considerations:

(*a*) the fairly straightforward question of the physical condition as an aircraft grows older;

(*b*) the more complex questions of the suitability, in respect of safety, of using aircraft of older designs in to-day's conditions.

Physical condition

87. In general, action is taken to prevent deterioration of the physical condition of aircraft, so that old age does not have a detrimental effect on the intrinsic safety of the aircraft.

88. Throughout their life, aircraft are subject to regular cycles of maintenance and overhaul. Limited programmes of maintenance are carried out at frequent intervals, and increasingly extensive overhauls at longer periods. At overhaul, parts are restored to an 'as new' condition or, if necessary, are replaced by new parts. Parts which are subject to fatigue are replaced before the end of their 'safe life'.

89. Based on experience of the condition found by inspection, the periods between overhaul or inspections are varied either upwards or downwards.

90. Thus the intention is, and this intention is realised almost completely, that the condition of aircraft, however old, is maintained very near to the 'as new' condition.

91. There is one qualification to make. Fatigue is brought about by repeated loading of the aircraft structure, so that as more and more repetitions of load occur the 'life' of the structure is used up. When fatigue can be predicted, or where the design is such that fatigue cracks can occur without danger, airworthiness is maintained by planned replacement and by inspection. However, it is still difficult, with landing gear, to predict the onset of fatigue or where cracks will occur. Thus though fatigue failures have occurred on relatively new aircraft, more usually they appear on older ones.

92. In relation to the overall safety level of an aircraft, this effect of age is a minor influence. It is not pretended that this is an entirely satisfactory state of affairs. The solution lies in the field of design and testing, as it cannot be solved by imposing arbitrary replacement lives or more frequent inspections.

Other effects

93. There are various factors affecting safety which are related to the age of types of aircraft, rather than to the age of individual aircraft. In short, these factors are as follows:

(*a*) as time goes on, airworthiness requirements are amended. Some changes are introduced to offset potential risks associated with new features of design, including the complexity of modern design. Some are intended to raise the level of safety. The new design is, therefore, intrinsically safer than an older one.

(*b*) the effect of (*a*) is lessened by virtue of the fact that newer requirements are sometimes, though not always, applied to older aircraft already in service.

(*c*) when a new type of aircraft enters service it always suffers accidents more frequently during a 'learning period'. This learning period, in which both operational practices and the airworthiness are improved, is often surprisingly long (e.g. 2 million cumulative hours may elapse before the accident rate settles down).

(*d*) older aircraft often pass out of the hands of major operators to smaller operators, from scheduled services to charter ones, from operations at well equipped airfields to less well equipped ones. Though not a true age effect, these events may influence the accident rate.

94. In general, therefore, some of these factors tend to counter-balance. The newer type of aircraft is designed to high standards but a long time elapses before the benefit is reaped. In theory, there is an optimum time at which, in the interests of safety, the old aircraft should be replaced by a new type. In practice, this optimum is hard to determine.

95. The accident records of six older types (introduced between 1943 and 1951) and six newer types (introduced between 1952 and 1960) have been studied (appendix J). As shown in table 1 of appendix J the average rate of notifiable accidents for the six newer types is about 25 per cent. better than the average for the six older types.

96. It is also instructive to examine the records of individual types. It is difficult to discover any clear pattern. Some of the oldest aircraft (Dakota, Constellation and Argonaut) show better than average notifiable accident rates, while others (Viking, Ambassador and DC4) are worse. The newer types adhere more closely to the average, both for notifiable and fatal accident rates, the Britannia (one of the older of the six new types considered) standing out as one of the best, in respect of notifiable accidents.

97. As regards overall trends with age, for the six older types of aircraft examined, the notifiable accident rate increased from 2·0 per 100,000 hours (in the period 1955–61) to 5·5 per 100,000 hours (in the period 1962–67). Appendix J, tables 2 and 3. When only those accidents assessed as being wholly or in part attributable to airworthiness factors are considered, the rates for the two periods are respectively, 0·8 and 1·5.

98. The fatal accident rate associated with airworthiness causes in fact shows improvement, but the sample is small and inconclusive.

99. Again, referring to individual types, after 21 years in service, the Dakota showed a worsening trend, while the Boeing 707 after 6 years shows signs of worsening. Others, such as the Viscount after 15 years, are still improving, as is the Comet after 9 years.

100. It therefore seems that the age at which it would be of benefit to safety to replace an aircraft is very variable and unpredictable. The increase in notifiable accident rate which has sometimes been observed to occur as the type gets older, seems to arise chiefly from changes in the nature of the operation.

Possibilities of improving airworthiness of older aircraft

101. As mentioned earlier, the airworthiness of aircraft is raised during their life by modifications. Usually these are specific modifications to overcome weaknesses shown by service experience of the particular type of aircraft (i.e. the learning process). Occasionally newer requirements are applied to all existing aircraft to raise the airworthiness level generally.

102. This more general application of new requirements is, however, limited. It is practicable to design a new aircraft to more stringent standards but is often impracticable to make basic changes to an existing aircraft. Changes to the structural strength, or the performance (i.e. take-off, climb, etc.) can readily render an aircraft totally uneconomic and with only marginal gains in safety. On the other hand, improvements in instruments or radio can be, and are, made.

Conclusion

103. At root, most safety aspects are capable of some improvement at an economic penalty. The task of safety authorities is essentially one of forming a judgment between safety and its cost. It is important when seeking improvement to select areas where the dividends are highest, i.e.: where, for a given expenditure of effort and cost, the highest return in safety is obtained. Improving the airworthiness of old aeroplanes is one facet of this process; in some cases the costs of improvement are very high relative to the safety benefits.

104. Looking at the record as a whole, it is considered that the balance which has been struck is a reasonable one.

CHAPTER 6

Conclusions as to Current Standards of Operators

105. The conclusions to be drawn from the Special Review must be qualified to some extent by the fact that investigations and inspections since the AOC was introduced have been lacking in both scope and depth. This was quite unavoidable and is no reflection on the staff concerned. We have consistently been asking one man to do the work of two—and often three. Nevertheless, the information provided during the period of the Review has been sufficient to enable us to make a well-founded assessment upon which definitive recommendations can be based.

106. The first and most important point to emerge is that the majority of operators—influenced, we believe, by the effect of the AOC machinery in recent years—are thoroughly responsible people who take not only the safety but also the quality of their operations seriously. We believe that the majority of UK operators operate to an entirely satisfactory standard. It is evident, however, that there are some who meet the minimum standards evolved for the AOC only by virtue of the close supervision and constant prodding to which they are rightly subjected. There is a tendency for the smaller operators to fall into this category.

107. The inevitable and relative instability of the climate in which the smaller operator functions introduces problems of staffing and provisioning which militate against the attainment of high standards.

108. Nevertheless it would be a mistake to assume that efficiency and safety are necessarily linked with size. There are clearly other factors to be considered.

109. Endeavouring to identify and define the factors that make one operator " better " than another, is similar in many respects—and generally as difficult —as pinpointing the fundamental causes of a number of accidents in recent years. Because of the developments and improvements in facilities and techniques in the air transport industry during the past twenty years, the obvious reasons for accidents should have been largely eliminated. Reasons and causes tend increasingly to be deep-rooted and more difficult to discern ; accidents seem more likely to have been caused by a number of factors which would not, individually, have been sufficient cause in themselves. Unless this is fully understood and appreciated, any attempt to identify the problems and to indicate remedies is unlikely to be effective.

110. A high and improving standard of operation stems from the many factors which together create what can best be described as the right environment. Where standards are relatively poor it is because the total environment is poor rather than the fact that this factor or that is below standard. It will be helpful, therefore, to list the major factors that influence the environment, and to comment upon their relevance to current standards as we see them.

Finance

111. It is essential that the available finance shall match the scale of operation. The lack of adequate financial resources has a significant and far-reaching effect on environment and morale, leading inevitably to some effect on operational standards. There is a danger that staff feel that they are obliged to tailor their actions and decisions to these circumstances, and perhaps unconsciously to accept slight reductions in standards. This is a normal human reaction, stemming from perfectly good motives, and we do not suggest there is any widespread foolhardiness from this cause. But we do consider it a relevant factor in some cases.

Operational management

112. A thoroughly competent management with adequate supporting staff is vital to the creation of a favourable environment. This is particularly the case in the operational aspects of airline operation. It is important that the operational management should be of the highest calibre and should at least have equal status and authority with the managerial staff who deal with the commercial or administrative side of an airline's affairs. It is our firm impression that in many instances there is a lack of operational management of the right calibre and status, and we believe this, too, must affect in some degree the standard of operations.

113. In our view, the primary cause of this situation can be found in the fact that the rate of growth and expansion in the air transport industry has been exceptional. One of the effects has been that a management structure and philosophy has had to be developed very rapidly and under great pressure. Many operators have not tackled the problem of training for management in the operational field. We believe this is essential. The tendency has been to select an operational manager on the basis of wide experience as an airline pilot, and although we believe this experience to be vital, we are also convinced that some degree of formal training in management techniques must be provided.

114. This clearly is a long term problem and it is not a matter upon which we can suggest Departmental action as we shall in respect of other matters discussed in this chapter. We think it appropriate to observe, however, that very considerable improvements have been brought about in this field by the effect of the AOC machinery.

Crew training and testing

115. The direct influence of the standards to which flight crews are trained and tested is obvious. From the habits and disciplines inculcated in the course of initial training and subsequent type conversion courses and periodical tests come the habits and disciplines of routine airline operation. With some operators the training effort is minimal and certainly does not match that of the Corporations; this factor will unquestionably have great significance with the increasing numbers of modern jet aircraft that are now being brought into service.

116. Since 1960, when the Tenth Schedule of the Air Navigation Order came into operation, setting out in some detail the training, experience, practice and periodical tests required for members of the crew of an aircraft engaged

on public transport flights, and followed a year later by the introduction of the Air Operator's Certificate, there has been a steady improvement in operators' training arrangements. As the result of the AOC requirement for all operators to produce a training manual, the process has been taken a considerable step further, in that operators have had to specify their training arrangements and set out model syllabi and tests.

117. It is our conclusion, based upon our Review and our general knowledge in this field, that there is a clear need for further improvement in the approach of many operators to training matters, and for a greatly increased effort to secure uniformity (and, in some instances, improvement) of standards among the airline captains assigned to training and testing duties. The current system of Departmental control, referred to in chapter 3, rests in large measure upon the delegation of authority and thus upon the integrity of both the operator and his training captains, and there is no practicable alternative. In general, the arrangement is satisfactory but the fact must be faced that with so many people involved there will inevitably be a small proportion whose integrity does not come wholly unblemished through the stresses and strains of day to day difficulties and commercial considerations. We believe the Department's arrangements for the early detection and correction of any such lapses must be improved.

118. In the great majority of cases, however, there is nothing lacking in the integrity of training captains. They are generally men of high principle fully conscious of their responsibilities in regard to safety. What is often lacking is sufficient specialised tuition in the techniques of training and testing, regular guidance and informed criticism, and the opportunity for free and helpful discussion with a specialist in the field. Here again, we believe that the Department's arrangements must be strengthened and improved, and that the inadequacy of past arrangements has stemmed primarily from a chronic shortage of Departmental staff and not from any lack of appreciation of the problem on the part of those responsible.

119. As soon as the CAFU Examining Unit is fully staffed, it should become a condition of appointment of all check captains, type rating examiners and instrument rating examiners that they should have successfully completed a course in examining techniques conducted by that Unit.

Flight deck management

120. The formal reports on the intensive line inspections that have been carried out for this Special Review are generally satisfactory, although as expected various deficiencies have come to light. This is not unusual and the normal follow-up action has been taken with the operators. Our view is confirmed that there is room for improvement in the standard of flight deck management in the course of routine operations. As we see it, the operation of an aircraft has become to a large extent an exercise in management and requires a thoroughly professional approach to the task. In our view, this is not appreciated enough. With a few notable exceptions in which UK operators have taken a lead in the development of the concept of flight deck management, we are led to the conclusion that operators should give this matter more attention. Flight deck management should form part and parcel of the general training and testing procedure to which we have referred

above. Teaching pilots to fly aeroplanes is no longer sufficient. They must be thoroughly trained, together with flight engineers and navigators, in the *operation* of their aircraft. Ground training, base and line training, and the associated tests, must be conceived and implemented as a whole. We do not want to suggest that the current situation in these respects is in any way a cause for alarm or drastic action, but we believe that improvements will be achieved only by constant and continuous probing by informed and objective observers who must look at the totality of the problem on the flight deck. A number of operators think on these lines and the results of their efforts are impressive. Many do not. And we believe in any case that there is need for the completely objective approach that can be brought to bear by the Flight Operations Inspectorate in engaging in sustained and properly directed observation on the flight deck in the course of normal operations.

Accommodation and working conditions

121. In some cases there is inadequate and cramped accommodation for all grades of operating staff which reacts in some degree upon the operating standards. Accommodation on airports is often exorbitantly expensive and there is evidently a link here with the question of financial resources to which we have referred. There is a link, also, with the question of the status of operational managers to which we attach considerable importance. The Flight Operations Inspectorate has already intervened to bring about improvements where conditions are particularly bad; recommendations have been made and the necessary improvements effected.

Aircraft maintenance arrangements

122. For the purpose of this Review the companies holding AOCs were divided by ARB into two groups; the first group consists of those companies who are operating aircraft to published timetables, either as regular scheduled services or as holiday inclusive tour flights, in addition to special charters; the second group consists of those companies operating fixed wing aircraft entirely on special charters, air taxis, etc. and helicopters used on scheduled services, oil rig services and special charters.

123. A re-examination of each company's maintenance facilities and their standard of maintenance has been made with the emphasis placed on the performance over the past 18 months. In addition the maintenance facilities and standards of those organisations who do not operate aircraft but whose commitments include contract maintenance to AOC holders have been re-examined.

124. The majority of companies in the first group are sufficiently large to have justified the establishment of their own maintenance organisations; the few companies in the group with very small numbers of aircraft have of necessity established regular agreements with specific maintenance organisations who do not generally operate aircraft themselves.

125. The second group of companies with fixed wing aircraft are generally so small that they have been unable to justify the establishment of their own maintenance organisation; the maintenance of their aircraft, which are small both in size and in annual utilisation, is frequently contracted out on an ad hoc basis to other companies who have man power available at the

particular time. This practice does introduce difficulties in communication which makes it virtually impossible to ensure identical maintenance standards on each aircraft.

126. The two helicopter companies both operate relatively large fleets from many small and generally temporary bases. However, each has properly established main maintenance bases which handle major maintenance and control lesser maintenance at the other bases.

127. Although it has been found necessary to criticise the maintenance standards of most operators in some detailed aspects, their present standards, or, as applicable, those of the contracted maintenance organisations, are considered adequate. It is unrealistic to demand standards above the national capacity and it is clear that this country's training facilities for both technical management and technicians has not been adequate to meet the rapid expansion in the operating side of the aviation industry since the last war.

128. Whereas the commitments of the two Corporations have increased yearly by relatively small increments, in the past ten years, the Independents' total commitments have increased substantially in annual utilisation and complexity of aircraft.

129. There has been some general improvement in the standards of maintenance of all operators since the introduction of the Air Operator's Certificate. At least part of this improvement has been brought about as a result of specific requirements demanded of operators with an Air Operator's Certificate.

130. It is considered that all operators at present have adequate maintenance and servicing equipment or suitable sub-contracts to cover their needs. However, the maintenance performance of all operators does vary year by year and there is invariably a short term drop in standards when new "equipment" is introduced into service. This short term lowering of standards can in the main be attributed to the operator's need to withdraw temporarily a number of his key engineering personnel from current commitments in order that they may receive technical training on new aircraft which the operator is proposing to introduce. Similarly, when this new "equipment" is introduced there is a certain inevitable dilution of key personnel in that they are required to ensure that the maintenance standards on the existing fleet are sustained and, at the same time, develop new maintenance procedures for the new aircraft.

131. The general standard of defect reporting and analysis, together with associated rectification, particularly away from base, is marginal in all operators. Although these cannot be shown to be direct causes of accidents, they might well be contributory causes and marked improvements in both these matters are essential.

132. Hangarage and workshop facilities at United Kingdom airports are very limited. With the exception of the two Corporations and British United Airways, virtually all operators' plans for immediate and future expansion are seriously complicated by this problem. The very high costs of ground rents, the difficulties and delays in obtaining local planning permission, and in some cases the lack of adequate power supplies and drainage and security

of tenure are typical reasons why operators are delayed in undertaking their own building programmes. As a result maintenance work is not infrequently carried out in conditions below desirable standards.

133. The enthusiasm of the employees of independent operators, together with their concern for their company's reputation generally balances the lower standard of workshop facilities and equipment which they have by comparison with the two Corporations.

134. Lack of technical and management training facilities has resulted to some extent in a lack of professional management in all but the larger operators.

135. These limitations in management are high-lighted by the significant lack of forward planning and allocation of associated finance, particularly by the smaller operators, when new equipment is introduced. They are also reflected in the companies' difficulties in providing adequate planning of support at route stations. These problems are aggravated by the variation in aircraft utilisation between winter and summer, which, in turn, results in key technical staff being invariably overworked during the peak summer season.

136. There is a lack of adequate training facilities in basic aeronautical engineering and a serious national shortage of qualified engineers in the following trades: electronics; instrument and flight systems. The relatively rapid introduction of more complex aircraft which is anticipated over the next two years will pose serious problems in this field.

137. In addition, with the exception of the Corporations, organised training arrangements for mechanics in relation to specific types of aircraft are lacking.

General conclusions

138. Nothing that we learned in the course of the Review has indicated that a Certificate has been allowed to remain in force which should have been withdrawn, and we consider that this is due in large measure to the efforts and influence of the staff concerned who have worked continuously under extreme pressure.

139. The Director of Aviation Safety has so far granted certificates to 88 operators; 26 have lapsed for various reasons; and 20 have been suspended or revoked. On 9 occasions, when operators' standards were seen by the Inspectors to have fallen below an acceptable level, the Director has given notice of his intention to suspend or revoke unless an improvement was effected; in six of these cases the Director was able to withdraw the notice upon being satisfied that the necessary action had been taken by the operator.

In only one instance did the operator appeal against the Director's decision, and the appeal was withdrawn before the matter came before the Court.

140. But these figures give no picture of the total effort entailed. For example, they cannot illustrate the extent of the work involved in dealing with inquiries about applications and projects which do not, in the event, materialise; they cannot indicate the effort expended in many instances to secure an improvement in standards and so to avert the necessity for formal

intervention by the Director ; nor can they convey a measure of the difficulties encountered in identifying the causes of deficiencies and defining them in a manner that will first ensure that the operators' legitimate rights and interests are respected, secondly that the reports and evidence produced by the inspectors are such that they will support any action that the Director may decide to take, and thirdly that the various legal considerations are taken fully into account so that the Director's decision is likely to be upheld on appeal.

141. Various case histories show in some detail the course of events from the time that standards first became suspect to the eventual resolution of the difficulties ; for example, by the withdrawal of the Certificate, by the operator going out of business, and by remedial action being taken on the part of the operator. Such cases illustrate the fact that inadequate (and occasionally altogether incompetent) management has been the greatest single difficulty with which the Director and his staff, and the Air Registration Board, have had to contend.

142. The industry, in the operating field as in others, is on the verge of developments far greater and more complex than any that have gone before. It is also important to appreciate the effect on the industry, and the potential effect on operating standards, of the large scale retirement over the next few years of the very experienced aircraft commanders currently in service. Younger pilots will be coming on the scene in greater numbers and they will more and more be operating large sophisticated aircraft. The questions of training and flight deck management will, in consequence, need particularly close attention. There will be a continuing and perhaps a growing need for the experienced, professional and objective influence of a well-managed corps of inspecting staff and we urge very strongly that every effort should be made to avoid the chronic staffing problems that have beset the Director and his staff over the past six years.

CHAPTER 7

Recommendations for Action by the Statutory Authorities

Part 1: Recommendations for action by the Aviation Safety Division of the Board of Trade

143. As indicated in chapter 6, the Review has led us to various conclusions upon which we feel we should make definite recommendations for departmental action, which in our view will lead, although perhaps indirectly, to an improvement in operating standards, thus helping materially to create an environment in which the highest standards can develop. In the main our recommendations will flow from the comments we have made, but in some respects the suggestions we have to offer are based on broad impressions we have gained and seem to us to be desirable courses of action even though they may not be related directly or obviously to any particular factor that we have discussed. Our first recommendation is of this nature.

Departmental responsibility for operating standards

144. We believe that the existing concept of a personal responsibility and statutory authority for the grant of Air Operators' Certificates and all that this entails, is a sound one. However, the Director of Aviation Safety has at present a dual role, as an official of the Board of Trade and as the statutory authority for the Air Operator's Certificate and sometimes these two functions overlap. They can also place a heavy burden on the Director, apart from various misunderstandings that can arise; it is considered that the Director should have none other than his statutory function, and have in his charge only the Flight Operations Inspectorate and such other elements as are necessary for the proper and effective discharge of his duties. There should at all times be a firm and direct chain of responsibility to the Director.

Recommendations for Departmental reorganisation

145. Accordingly we recommend that:

(*a*) the official in whom the statutory responsibility is vested is technically and operationally competent and of sufficient status in the Department to be able to maintain effective liaison at the right level and to act as a consultant to the most senior officials whose policy making functions impinge on the operational field;

(*b*) the title of this official should be changed to "Director of Flight Operations"; the title in current use, "Director of Aviation Safety", is neither descriptive of the role performed nor the function and it is often confused with that of the Director of Flight Safety;

(*c*) the Director of Flight Operations should, like the Chief Inspector of Accidents, be responsible direct to the President of the Board of Trade for the execution of his statutory role;

(*d*) An operations director, the "Director of Training and Licensing" should be set up, to take over those functions of the Director of Aviation Safety which he performs as an official of the Board of Trade and not in his statutory role, including the appointment (and training where necessary) of all authorised flight examiners. Although this new Directorate would be responsible for all pilot licensing matters, and for policy on ab-initio and airline training including the approval of courses in both spheres and of flight simulators, full responsibility for the implementation of the approved type rating training within AOC companies would rest with the proposed Director of Flight Operations.

(*e*) The Director of Flight Operations should have direct control of all matters in the Civil Aviation Flying Unit connected with the Air Operator's Certificate, thereby putting the Flight Operations Inspectors and the Flight Examiners, whose grade is common, and whose work is in many respects complementary, under one Director. This concept must in no way detract from the services provided by the Flying Unit for the Chief of Telecommunications, and arrangements could be made for one Deputy Commander to report, except for normal administrative matters, to him direct. The duties and responsibilities of the Director of Flight Operations and the Director of Training and Licensing and those of the Commander of the Civil Aviation Flying Unit would need to be re-defined. Suitable arrangements would have to be made to ensure that all pilots in the Unit were kept in flying practice.

146. We must stress at this stage that we consider the above recommendations to be of fundamental importance. As with an airline, the operational efficiency of the Departmental machinery is dependent first and foremost on a sound management structure, clear definition of duties and responsibilities and chain of command, as well as the qualifications and status of the management and executive personnel. Unless the basic organisational structure is sound the further recommendations that follow could not be fully effective.

Airline financial status

147. In paragraph 111 of chapter 6 we commented on the influence of the financial status of an airline. Although this is a matter with which the Air Transport Licensing Board is concerned we do not feel that current arrangements are adequate for the purposes of the proposed Director of Flight Operations and the proper discharge of his responsibilities. We envisage that he ought to be able to obtain advice and recommendations about an airline's financial status and resources as the Director of Aviation Safety currently does from the Air Registration Board in respect of aircraft maintenance arrangements.

Airline management

148. Although as indicated in chapter 6, paragraphs 112-114, we cannot suggest Departmental action on the provision of facilities for management training, we nevertheless feel there would be considerable benefit in occasional conferences in which the operations and technical managers of all public

transport operators could participate. It would be preferable if such gatherings could be arranged outside any Government office so as to avoid any impression of formality. Such conferences would seek to stimulate interest in the broader issues and changing conditions of airline administration and help senior officers of the operational and engineering departments to face those changes with understanding and skill.

Accommodation and working conditions for airline staff

149. We have indicated (paragraph 121 of chapter 6) that the inadequacy of certain operators' accommodation can be an adverse factor. We recommend that the Director should specify clearer requirements in this respect and make them known to both the inspecting staff and the operators. This is already done in respect of schools approved for ab-initio flying training.

Crew training and testing

150. To deal with the factors discussed in paragraphs 115-119 of chapter 6 we make the following recommendations:

(i) it should be a condition of appointment as check/training pilots that all such pilots should have successfully completed a standardisation course in examining technique, conducted by the Board of Trade. In other words this course, which is at present limited to instrument rating examiners, should be extended to all check pilots.

(ii) the number of training and test flights observed by Board of Trade officials should be greatly increased.

(iii) the purpose of the observation should be more clearly defined and should be seen to be the maintenance of essential liaison between airline examiners holding authority delegated by the Board of Trade, and effective control over the quality of both examiners and examinees.

(iv) to provide a proper basis for the assessment of an operator's competence in this field, there should be a progressive move away from the observing of single isolated tests carried out by one or two delegated examiners towards the intensive supervision of a concentrated series of tests in the same company. It is evident that small scale sampling as currently conducted does not give an adequate picture of an operator's standards and that there is a requirement for something more in the nature of "batch" sampling.

(v) if this is to be achieved it will be necessary for Board of Trade Inspectors to work much more in teams than hitherto. It is also desirable, as we have indicated in Chapter 6, that there should be much closer co-ordination between "training" in the esoteric sense and line operation, and also between the Inspectors concerned. To this end, we recommend the formation of a training and testing "standardisation unit" staffed by suitably qualified people from both the CAFU and the Flight Operations Inspectorate. There are resources of experience and expertise in both organisations which are not being fully effectively utilised under the present arrangements and in our view they could usefully be brought together in such a unit.

(vi) such a team would have a dual function, to report to the Director of Training and Licensing, on the continued competence of training captains and authorised examiners, and to the Director of Flight Operations in respect of AOC holders' implementation of approved type rating training and arrangements for maintaining the competence of aircrew. Since the Director of Flight Operations with his statutory responsibility has to be satisfied with the competence of the operator, the team when dealing with AOC holders, would answer direct to him and copies of all reports would also have to go to the Director of Training and Licensing for action as necessary in respect of pilot licensing matters. The closest liaison between the two Directors would clearly be necessary. When acting outside the AOC field the standardisation unit would act upon the instructions and report direct to the Directorate of Training and Licensing, copies of reports going to DFO. There would thus be established a vital continuity of thought and purpose in the training of the airline pilot from the ab initio stage to the left hand seat.

151. Such an organisation would parallel the Department's proposals for a review of those provisions of the Air Navigation Order that relate to pilot licensing and pilot competency, against the background of modern aircraft operations. In writing, on the 9th March 1967 to the various operators, the Director of Aviation Safety stated:

> In making this review of the professional pilots qualifications against the background of the job to be done it will be necessary to ensure that the content and scope of the initial training course, the syllabi for the written and oral examinations, the kind and extent of flying experience, the continuation training and the periodic competency checks are all in line with the privileges that the licences and their associated ratings will confer. It will also be necessary to define clearly the allocation of responsibility for the content of all training and checking.

Flight deck management

152. We recommend a much more intensive programme of inspections in flight (chapter 6, paragraph 120) and increased attention to the question of flight deck management. The purpose of this activity should be re-defined from time to time as necessary in the light of changing circumstances and operational development. We know that this has been the Inspectorate's aim for some time and that only the shortage of staff has prevented the development of this aspect of its work. We believe the plans for further work in this field are sound and that they should be given every encouragement. It is on the flight deck that the incipient causes of accidents are likely to be found; it is there that the Inspectors will develop a full appreciation of the changing circumstances and problems confronting the airline pilot and be able to gather useful material to feed back into the policy making and operational divisions of the Board of Trade. If the recommendations in paragraph 150 above are also adopted, the essential link between "base" and "line" will be more strongly forged and the operational field will more readily be conceived in terms of totality and an inter-relation of the factors that engender the environment of which we have written.

Part 2: Recommendations for action by the Air Registration Board

153. The ARB's procedure for the examination of AOC applicants' maintenance facilities and the monitoring of the maintenance practices used by AOC holders, is virtually an extension of the ARB's established procedures for the control of airworthiness in the United Kingdom. These latter procedures have been developed over a period of some thirty years and it has not therefore been found necessary to recommend any major changes in the ARB AOC procedure as a result of this Review. However, some changes are necessary and these are elaborated below.

154. The present practice of the AOC team involves some duplication of effort between this team and the Area Surveyors. During the introductory stages of the AOC this duplication was justified to reduce the variation in standards previously set up by different areas; it is no longer justified. A reallocation of duties should be undertaken.

155. The majority of scheduled maintenance and overhaul is carried out during normal working hours and can thus be adequately supervised by ARB. Non-scheduled maintenance, defect rectification and unscheduled component changes frequently involve the operator in work outside normal hours and/or away from base. Although there is no evidence that this work is the cause of accidents or incidents, the standards applied are often lower than normal. The AOC team's work is, therefore, being reviewed in order to provide supervision of operators at week-ends and at route stations in the United Kingdom and abroad, and appropriate finance should be provided to meet the additional costs.

156. Present legislation permits individual licensed engineers to take full responsibility for the maintenance standards achieved on individual aircraft. Under this system the ARB has relatively little control of the standards under which the engineer elects to work. It can merely take action subsequent to a proven failure by the engineer concerned. It is unrealistic to expect an individual and possibly junior engineer to take full responsibility for the airworthiness state of a complex aircraft at any one time. The alternative system of prior ARB approval and thus control of a complete organisation is already practised in the construction and overhaul fields; steps should be taken to facilitate the introduction of formal approval by the ARB of maintenance organisations.

157. Recommendation for AOC approval is at present based on the operator's own or sub-contracted maintenance facilities; the operator's maintenance commitments relative to his anticipated fleet utilisation are not taken into account. Surveys of maintenance facilities should include a review of the anticipated utilisation. The ARB should examine the possibility of publishing a detailed code of practices which would establish requirements for minimum staff and facilities in an operator's organisation.

CHAPTER 8

Summary of Conclusions

158. This Special Review which was instituted as the result of two fatal accidents in June last year to passenger-carrying aircraft, has concerned itself with the performance, in respect of safety standards, of operators of United Kingdom registered public transport aircraft over 5000 lb. maximum all-up weight. Each such operator is required to hold an Air Operator's Certificate issued by the Director of Aviation Safety who is advised by the Air Registration Board on engineering and maintenance aspects.

159. There is no evidence that any aircraft operator currently in possession of an Air Operator's Certificate is not competent to secure the safe operation of aircraft within the terms of the Certificate, or that any type of aircraft currently in use is below an acceptable level of airworthiness.

160. With regard to the effects of age on airworthiness, the concept that there is a deterioration in the physical condition of old aircraft is, in general, false. It is true, however, that the newer aircraft are to a higher design standard than the older ones. The variations of airworthiness from generation to generation, and of airworthiness of a particular type as it grows older, are very complex and difficult to predict. A policy of retirement of aircraft at an arbitrarily defined age would not necessarily lead to improved airworthiness overall. Certainly the cost would be out of all proportion to any improvement achieved in the safety level.

161. The safety level of the United Kingdom civil air transport undertakings taken as a whole has improved over the past ten years and is of the same order as that achieved on average by the various contracting states of ICAO, but below that achieved by the airlines of the United States and Australia.

162. The overall safety level of United Kingdom Independent operators taken as a whole over the last ten years and in each five-year period was significantly lower than that of the Corporations taken together. It is recognised that the circumstances of the independent operators differ from that of the Corporations.

163. It is rarely possible to look at an accident and to isolate a single failure as the cause. In any study of accident experience an attempt is made to identify the underlying factors; in this respect the general conclusion is that most accidents are related to the overall operational environment. Any improvement in safety level depends in large part therefore on a general improvement in operational environment, including ground facilities.

164. Safety cannot be secured cheaply. Those who have conducted this Review have the impression, without actual study of the financial resources of airlines, that airlines find that the achievement of high standards of operation and maintenance is very costly, and in some cases this puts a severe strain on available financial resources. It is essential that the

available finance shall match the scale of operation, otherwise standards of operation and maintenance will tend to fall, morale will be lowered and all of this will have a significant and far-reaching effect on operational environment.

165. A thoroughly competent management with adequate supporting staff is vital to the creation of a favourable environment. Unfortunately many operators have not tackled the problem of training for management in the operational and technical fields and management resources in general are spread thinly, and as a result more frequent attention by the Directorate of Aviation Safety and the Air Registration Board has been necessary. The Directorate has been grossly understaffed to meet this heavy burden.

166. With regard to the operators' arrangements for pilot training, in the great majority of cases there is nothing lacking in the integrity of training captains or of pilots in general. They are men of high principle fully conscious of their responsibilities in regard to safety. However, with a number of operators there is a need for improvement in respect of specialised tuition in the techniques of training and testing; ground training, base and line training must be conceived as a whole. Crew members must be trained to work together as a team in the operation of the aircraft; there is room for improvement in the development of flight deck management techniques.

167. In some instances hangarage, workshop and office facilities are limited, and for a variety of reasons construction of new or adaptation of existing buildings often lags behind the expansion of air services. As a result maintenance work and the planning and supervision of flying operations are not infrequently carried out in conditions below the desirable standards.

168. There is a scarcity of training facilities in the nation as a whole, both for technical management and for engineers. The increasing complexity of modern aircraft urgently demands much more exacting standards of maintenance and overhaul arrangements and this trend will continue.

169. In all of these matters the situation is aggravated by the relatively large number of small operators. It is clear that from both the operational and airworthiness points of view some of the small operators work under considerable difficulties. Their size and perhaps lack of finance give rise to problems in forward planning and provision of training as well as of adequate technical support of aircraft away from base.

170. Present legislation permits individual licensed engineers to take full personal responsibility for the maintenance standards on individual aircraft. The system of approval of the complete organisation, already applied in the overhaul field, could with advantage be applied also in the maintenance field.

171. From these general considerations and despite the fact that safety and efficiency are not necessarily linked with size—there are some very good small operators—there can be little doubt that, in the operation of the larger and more complex public transport aircraft, adequate operational, maintenance and overhaul arrangements would be easier to attain if there were fewer and stronger operator units, thereby creating a better environment for the safety of travel by air.

172. In the course of this Review attention has been paid to the organisation and responsibilities of the Aviation Safety Division of the Board of Trade and of the Air Registration Board. The Directorate of Aviation Safety has suffered many staffing difficulties and in particular, until recent months, the Flight Operators Inspectorate has never effectively been at more than half the complement that is accepted as necessary. The Civil Aviation Flying Unit has been no better placed. The organisation and complement of the sections which deal with pilot licensing and training matters had become increasingly inadequate for their task; they have now been reorganised.

Some minor improvements in the arrangements of the Air Registration Board are in hand.

173. While, as stated above, the United Kingdom safety record is up to the level of most ICAO countries, it must be improved and further attention must be given both by the Department and the industry to the overall raising of standards. The special study that has been made of the accident records of all United Kingdom operators has shown that timely information not only on notifiable accidents but on *all* occurrences that could endanger aircraft would be a valuable means of preventing accidents.

CHAPTER 9

Summary of Recommendations

174. Our recommendations are as follows:

(1) the Director of Aviation Safety, Board of Trade, should have none other than his statutory role and his title should be changed to "Director of Flight Operations".

(2) a "Director of Training and Licensing" should be appointed whose duties would include those other functions at present carried out by the Director of Aviation Safety.

(3) in order to fulfil his statutory duties, the Director of Flight Operations should have, directly responsible to him, an adequate and properly trained staff.

(4) the Director of Flight Operations should have direct control of all matters in the Civil Aviation Flying Unit connected with the Air Operator's Certificate. Appropriate arrangements should be made to ensure that all pilots are kept in flying practice.

(5) rates of pay for the Board of Trade flying staff should be realistic in the light of salaries paid in the aviation industry generally.

(6) Board of Trade Flight Examiners should move away from observing single pilot competency checks and from time to time concentrate on observing a series of tests in each company.

(7) as soon as the CAFU Examining Unit is fully staffed, it should become a condition of appointment of all check captains, type rating examiners and instrument rating examiners that they should have successfully completed a course in examining techniques conducted by that Unit.

(8) the Director of Flight Operations should be enabled to take account of an operator's financial status and resources when considering the grant and continuance of an Air Operator's Certificate. We envisage that he ought to be able to obtain advice and recommendations in this respect.

(9) the Air Registration Board should examine the possibility of publishing a detailed code of practices which would establish requirements for minimum staff and facilities including hangarage in an operator's organisation.

(10) steps should be taken to facilitate the introduction of formal approval by the Air Registration Board of maintenance organisations.

(11) the Board of Trade and the Air Registration Board should require that all occurrences that could endanger aircraft should be brought to light and used by operators for accident prevention purposes.

Such occurrences should be brought to the attention of the Director of Flight Safety in the Board of Trade for the purpose of safety analysis. The existing arrangements whereby operators report defects to the Air Registration Board should of course continue.

(12) operators should pay particular attention to the improvement of flight deck management, the principles of which should form part of the general training and testing procedures; there should be much closer co-ordination between ground and base training and line operation.

(13) operators should arrange for better training for management for senior staff in both the operational and engineering fields, and for training of engineers and mechanics on a wider scale.

(14) in view of the comments in the Report on lack of training facilities for technical management and for engineers, it is recommended that the Civil Air Transport Industry Training Board should be invited to give priority to these aspects.

(15) the authorities conducting this Special Review have had in mind the terms of reference of the Civil Air Transport Inquiry recently set up under the chairmanship of Sir Ronald Edwards. These are as follows:

> To inquire into the economic and financial situation and prospects of the British civil air transport industry and into the methods of regulating competition and of licensing currently employed; and to propose with due attention to other forms of transport in this country what changes may be desirable to enable the industry to make its full contribution to the development of the economy and to the service and safety of the travelling public.

Throughout the text of this report comments have been made on underlying features of the structure of the air transport industry which are considered to have an important bearing on safety. It is therefore recommended that the report should be placed before the Edwards Committee, together with the views of the Independent Advisers.

CHAPTER 10

Comments and Recommendations by Captain F. A. Taylor

Independent Adviser

Introduction

175. This is primarily a review of the safety performance of the United Kingdom air operators by the two authorities concerned, namely the Air Registration Board (ARB) and the Director of Aviation Safety (DSA).

176. As an Independent Adviser, I have extended my own investigations to cover a somewhat wider field for two reasons: firstly, it has been apparent from the outset that any worthwhile inquiry would need to take a broader view of the aviation safety situation in the United Kingdom; secondly, the independent advisers have been invited to submit comment on any matter which they considered relevant.

177. The ARB and DSA when considering how best to implement the wishes of the President of the Board of Trade regarding a review of safety performance, concluded that the most logical and most practical course of action would be to intensify the investigations and inquiries which are in fact the normal procedures of their organisations. As a supplement to this, they decided to undertake a special examination of the accident records including those relating to older aircraft.

In my view this was the correct and only practical course of action.

178. Without in any way attempting to underrate the very considerable effort applied to the task or the results achieved, I think it appropriate to draw attention to certain limitations of the investigation.

179. It must be recognised that a *detailed* check of every aspect of the safety performance of the 40 or so operators would be a prodigious task beyond the manpower availability of the authorities concerned. The staff involved in the Special Review had their normal duties to perform, accordingly, there was a physical limit to the time and effort which could be allocated to the project. This aspect of the situation has been aggravated by the serious understaffing of the Directorate of Aviation Safety and the Civil Aviation Flying Unit (CAFU) over a prolonged period.

180. I would have preferred more flight inspections and flight tests to have been carried out by the Flight Operations Inspectorate and the CAFU during the course of the Review, as the observations of a trained inspector or examiner on the flight deck of an aircraft provide a quick and sure way to form a judgement on the competency and safety of both operator and pilot. Unfortunately this has not been possible for the reasons stated earlier.

181. In spite of these limitations, I am of the opinion that the total investigations carried out have been sufficient to provide a reasonably reliable indication of the present safety standards.

182. Any investigation of air safety tends to become an investigation in depth. The detailed consideration of any particular aspect is so often related to more general matters that the problem has to be viewed in its entirety. It is not surprising, therefore, that those conducting the Review have commented on the manner in which the various departments and organisations having responsibilities for the regulation of air safety have functioned in practice. Certain modifications to departmental procedures have also been proposed.

183. For my part I have thought it proper to offer comment on a number of matters which bear upon the subject of aviation safety, although perhaps not always related directly to the safety performance of operators, in the hope that the observations might be of help to the President of the Board of Trade when these particular matters are under consideration.

184. Throughout the course of the inquiry, the ARB and the Board of Trade have provided full access to all relevant information and have been frank and open in all discussions on the various matters under review. I should like to express my appreciation of the co-operation and help which I have received from those concerned and of their patience and understanding in dealing with the searching and challenging inquiries which I thought it right to make.

Part 2 : The Review of Accidents

185. This is the foundation upon which the whole of the Safety Review is based. The conclusions reached are of outstanding importance. So also are the basic considerations and principles on which these conclusions rest. At the risk of repeating what has been said already in the accident review, I would like to emphasise one or two points which seem to me to merit the fullest consideration and appreciation.

186. The assessment of an operator's safety performance is not a simple matter. The only quantitative measure available is the relatively small sample provided by the record of notifiable accidents. A further difficulty arises from the fact that there is no absolute standard against which a particular performance may be measured. For this reason the procedure normally adopted is to compare the performance of one group with that of others in an attempt to assess whether it is average or better or worse than average. Since the possibility of one group being identical with another is remote, we are seldom comparing like with like and in these circumstances the limitations of the comparison must be appreciated.

187. When making comparative assessments much depends on the choice of the particular " indicator " (i.e. the number of notifiable accidents or the number of fatalities, etc.) and the " criterion of exposure " (i.e. per 100,000 stage flights or per 1 million passenger miles, etc.). Different " indicators " and different " criteria of exposure " can produce widely divergent results. There is a temptation to select one particular comparison because it appears to have greater merit than the remainder and because this course of action simplifies the subsequent analysis. I concur with the view expressed in the Report that 'it is easy to arrive at invalid conclusions by using one rate

alone' and support the contention that the best approach is to consider a number of comparisons side by side before making a judgment on the situation.

188. During the course of our deliberations we were presented with the argument that we should base our conclusions on the statistics relating to the number of notifiable accidents per 100,000 stage flights. Since most accidents occurred in the take-off and landing phases, it was argued, this would be the best criterion. For the reasons already mentioned, I took the view that this would be an over-simplification and that conclusions based solely on this criterion, which ignored distance or hours flown, could be incorrect. The following excerpt from the American Institute of Aeronautics and Astronautics Paper No. 66–805 by Mr. A. M. Lester supports this viewpoint:

> There are a number of accident risks en route that are greater for long flights than for short ones, and the element of distance flown sometimes enters into the causation even of landing accidents. The risks of fatal accident associated with a long flight are certainly greater than those associated with a short flight, even if not directly proportional to the distance flown.

189. Another argument advanced was that the safety review should be concerned only with the *causes* of accidents and not the *results*. I found this argument difficult to accept. It seemed to me that we were not interested in safety performance as a theoretical exercise: we should be interested in the results of accidents as well as the causes because, quite apart from the obvious sociological aspects, the results play a very important part in the growth and development of the industry as a whole. For this reason I believe that statistics based on fatal accidents and fatalities should receive their proper emphasis alongside other statistical evidence.

190. There are one or two notable gaps in the information resulting from the review of accidents. It would have been helpful, for example, to have been able to consider the safety performance of charter operations in relation to scheduled operations, or, again, the record of individual companies in relation to the overall average. Apparently the evidence available on these points was insufficient to provide a basis for a reliable assessment.

191. The Director of *Flight* Safety and his staff and the representatives of the ARB are to be congratulated on the excellent work which has been done in connection with this review of accidents. The report they have prepared represents a material contribution to aviation safety in its objective and logical analysis of the situation and in the all-important judgments made as to the proper interpretation of the statistical evidence.

192. I recommend to the President of the Board of Trade that this report (chapter 4) should receive a wide circulation throughout the aviation industry. Although primarily of benefit to civil aircraft operators and their flying and engineering staff, there are lessons here for aircraft designers and manufacturers and appropriate government officials.

193. I concur with the conclusion contained in chapter 4 and support the recommendation that the procedures should be amended to ensure that not only "notifiable" accidents but *all* occurrences that could endanger safety

are notified in future. In this connection the United Kingdom should use its influence through ICAO and IATA to achieve a similar extension of reporting procedures on an international basis.

194. In an industry which spends vast sums of money annually on safety considerations, it is surprising that insufficient attention is paid to the primary tool for measuring safety, namely, the statistical evidence based on *all* accident experience world-wide.

Part 3: The Examination of the Effects of Age of Aircraft on Safety

195. The ARB in conjunction with the Directorate of Flight Safety has made a close study of this subject. The results of this examination would seem to be as follows:

(i) the established system of maintenance, overhaul, repair, replacement and modification ensures that an aircraft's condition is kept virtually 'as new' irrespective of its true age. There is a qualification here in regard to fatigue.

(ii) in general, newer aircraft are designed to more stringent performance standards than their predecessors.

(iii) it is usually uneconomic and often impossible to modify an older aircraft to meet the performance standards required of newer aircraft.

(iv) the increase in the notifiable accident rate of older aircraft in the last 6-year period arises chiefly from operational causes.

(v) a policy of early retirement of aircraft at an arbitrarily defined age would not necessarily lead to improved airworthiness overall: certainly the cost would be out of all proportion to any improvement achieved in the safety level.

196. Whilst I agree with these general conclusions, I feel bound to add that paragraph (i) above will only hold good if maintenance, overhaul, repair and modification are to the highest standards. Where standards are no more than 'adequate', and this would seem to be the case with a number of operators, there will be a tendency for the condition and the performance of aircraft to deteriorate as time passes.

Part 4: The Conclusions as to the Current Standards of Operators

197. Chapter 6 contains detailed comment on this subject by the ARB and DSA.

ARB

The key sentence would seem to be the following:

> "Although it has been found necessary to criticise the maintenance standards of most operators in some detailed aspects, their present standards . . . are considered adequate. It is unrealistic to demand standards above the national capacity and it is clear that this country's training facilities for both technical management and technicians has not been adequate."

DSA

Great importance is attached to the fact that a high standard of operation stems from the right environment and the major factors which influence environment are discussed under the following headings:

Finance
Operational management
Crew Training and Testing
Flight Deck Management
Accommodation and Working Conditions.

Two important conclusions may be highlighted:

> ". . . the majority of operators . . . are thoroughly responsible people who take not only the safety but also the quality of their operations seriously . . . It is evident, however, that there are some who meet the minimum standards evolved for the AOC only by virtue of the close supervision and constant prodding to which they are rightly subjected."
>
> "Nothing that we have learned in the course of the Review has indicated that a Certificate has been allowed to remain in force which should have been withdrawn. . . . "

198. An examination of the confidential reports which have been prepared in respect of each operator suggests that a number of companies have maintenance or operational standards which are "marginal". Chapter 6 probes further into some of the underlying causes of these lower standards and recommendations designed to bring about an improvement in the situation are contained in chapter 7.

199. Broadly speaking, I am in agreement with the substance of chapter 6 but there are two points which have claimed my attention and are deserving of further consideration.

200. First, how do we correlate the fact of the unsatisfactory safety level of the independent operators as a whole, as indicated in the review of accidents, with the conclusions reached by the ARB and DSA? At first sight there would seem to be only two possible explanations: either the accident statistics are not a reliable indication of safety level, a proposition which would be difficult to substantiate, or the standard of operations demanded of the independent operators is too low. Discussion with DSA suggests that the explanation may lie elsewhere. Any corrective action taken by DSA in regard to an operator's lowered safety standards must be of necessity remedial rather than preventive. The revocation of an AOC or even less forceful action requires firm evidence which would be legally valid. This is not always easy to obtain and a considerable lapse of time may ensue between the DSA's first suspicions and his corrective action. This time lag permits lower safety standards and hence a poorer safety record overall.

201. Secondly, the comment contained in chapter 6 is on the whole generalised and there is little differentiation between the two nationalised Corporations and the independent operators. This is unfortunate because it neither indicates nor stresses what I believe is the true situation, namely, that the Corporations and the Independents are poles apart in many aspects

of this matter. I do not say this to extol the virtues of the Corporations but to indicate the very serious difficulties under which the Independents have to operate.

202. The greater part of the adverse comment from the ARB on lack of technical and management ability, lack of training facilities, lack of forward planning, and lack of finance surely cannot apply to the Corporations. Nor can much of the comment of DSA on finance, operational management, crew training and testing, flight deck management and accommodation and working conditions. The Corporations are certainly not free from criticism but they are free from a good deal of the criticism in chapter 6.

203. If we face up to the realities of the situation we must recognise that the very real difference in safety performance between the two Corporations on the one hand and the independent operators on the other is most likely due to the different climates in which the two groups operate from the following aspects:

1. the opportunity to operate in favourable markets
2. the lack of a clear policy of air service licensing
3. the amount of Government support or opposition
4. capital resources and capital structure
5. revenue earning potential
6. aircraft types
7. the type of operation.

204. Although there may be protestations from some quarters to the contrary, the fact remains that all these matters impinge on aviation safety, and the instability and frustration in the Independent section of the industry, which is a frequent subject of comment nowadays, cannot be ignored in this present study.

205. To a large extent the operational environment, which DSA considers to be at the heart of the air safety problem, stems directly from the factors enumerated above.

206. I believe that a realistic examination of operational environment can only be made with a full recognition of the great gulf which exists between the Corporations and the Independents. Any attempt to ignore or minimise this will only serve to diminish the value of the assessment.

Part 5: The Recommendations for Action by the Statutory Authorities

207. Chapter 7 contains a number of recommendations for departmental action some of which involve modifications to the machinery to deal with the Board of Trade's responsibilities in air safety matters. These are well-conceived and progressive suggestions which merit careful consideration and in general have my support. At the same time I must state quite frankly that in my view some of the proposals do not go far enough and do not always get to the grass roots of the problem.

208. In particular, I consider that the aviation safety function in the United Kingdom must be integrated to be fully effective: the present fragmentation of effort between the various departments and organisations inside and outside of government lacks the benefits of a unified and co-ordinated organisation which alone will provide efficiency, economy and higher levels of safety. Nor do I believe that there is room for compromise on a vital issue of this nature.

209. With these thoughts in mind, I have prepared a paper, attached as appendix N, which examines the manner in which the Directorate of Aviation Safety has functioned and gives suggestions for an outline plan for a basic reorganisation of the total aviation safety function in the United Kingdom.

Further papers, attached as appendices K, L and M, offer independent comment on other aspects of the air safety problem.

Part 6: Personal Recommendations

210. My recommendations are as follows:

(1) that the Edwards Committee take note of the views expressed in this Safety Review Report in regard to

  (*a*) the relationship between the structure of the air transport industry and aviation safety;

  (*b*) the relationship between the functioning of the Air Transport Licensing Board and aviation safety.

(2) That a unified control of the aviation safety function in the United Kingdom be established in place of the present fragmented organisation in order to improve aviation safety itself.

(3) That the Review of Accidents (chapter 4 of the Review report) should receive a wide circulation throughout the aviation industry.

(4) That there should be a change of emphasis in the approach to practical measures to improve safety. The pre-eminent problem of 'pilot error' should be dealt with by a more direct approach.

CHAPTER 11

Note by Sir Frederick Brundrett

Independent Adviser

210. This report seems to me to go far beyond the requirements of the statement in the House by the then President of the Board of Trade on 28 June 1967. The result is that it has taken a great deal longer than it should have done.

211. I think the Independent Advisers, with their natural desire to be clear about what the arrangements are and how they work, are, to an appreciable extent at least, responsible for this. However that may be, I suggest that those parts of the report which deal with matters outside the review of operators' performance would have been better carried out under the aegis of the Edwards Committee.

212. So far as the review of the operators' performance is concerned, it seems to me that the statutory authorities have done the best they possibly could in the circumstances. Two things seem to me to be clear from it. The first is that any operators working under conditions of severe financial strain must find it extremely difficult to comply with all the requirements laid down to ensure safety. The second is that whatever criticisms may be laid at the door of the statutory authorities, there is no doubt at all that their activities have been beneficial from the safety point of view.

213. I cannot help feeling that the responsibility of judgment thrown upon the statutory authorities in the matter of the adequacy of the operators' financial resources is very difficult indeed, and I hope the Edwards Committee will give particular attention to this point.

214. Insofar as the remainder of the report is concerned, it is abundantly clear that the organisation in the Board of Trade is unnecessarily complicated and requires appreciable modification. What form that modification should take must, I think, depend very largely on the recommendations of the Edwards Committee about the future of the industry.

215. I must, however, make one comment on the situation as it has been. If the approved system of supervision is agreed to depend on a programme of inspections, it is quite absurd to think that this can be properly carried out without adequate staff of the right calibre. It does not seem to me that the necessary steps have been taken to ensure that the Director of Aviation Safety was supplied with the necessary staff or that the conditions of service of these staff have been such as to attract the necessary quality of individual.

APPENDIX A

(Chapter 1 refers)

Persons and Organisations who Submitted Written Representations

The Air League
Mr. T. Bolt
The British Air Line Pilots' Association
The British Independent Air Transport Association
Mr. R. Clarke
Mr. T. T. Griffiths
Captain H. A. Hopkins
Captain E. N. Jennings MBE, DFC
Mr. J. A. Karran OBE, AFC, MA
Mr. F. A. Laker FInstD, ARAeS, MSLAET
Mr. A. J. Lucking
Mr. Ian Mikardo MP
Mr. J. E. D. Williams BSc, FIN, FRAeS

APPENDIX B (i)

(Chapter 2 refers)

Directorate of Aviation Safety: Terms of Reference

The Directorate of Aviation Safety comprises the Flight Operations Inspectorate, the Deputy Directorate of Aviation Safety (Licensing) and the Weather Minima Section. Their responsibilities are described section by section:

Chief Flight Operations Inspector

SA(I)1 Preparation of instructions and guidance to Flight Operations Inspectors. Preparation of information to operators concerning the requirements for the grant and retention of Air Operators Certificates.

Development of inspecting and reporting procedures. Arrangements for training of Inspectors.

Supervision and inspection of the following operators: Airways Training Ltd., BKS, BOAC, Civil Aviation Flying Unit, Gregory Air Services, Gulf Aviation.

Examination of standards and inspection of operators facilities for long range navigation.

SA(I)2 Supervision and inspection of the following operators: Air Ferry, Bristow Helicopter, BEA Helicopters Ltd., BUA, BU(CI)A, BAF, Caledonian Airways, Skyways Coach Air, Emerald Airways, Laker Airways, Morton Air Services, Northair Aviation Ltd.

SA(I)3 Supervision and inspection of the following operators: BEA, Britannia Airways, Cambrian Airways, Cardinal Air Taxis, Channel Airways, Cyprus Airways, Gibraltar Airways, Kentair Charters, McAlpine, Tacair, Trans-Meridian Airways, Transglobe.

SA(I)4 Supervision and inspection of the following operators: Autair, British Midland Airways, Dan Air Services, British Eagle International Airlines Ltd., Glos-Air, (AOC granted 8.12.67) Invicta Airways, Lloyd International, Loganair, Strathair.

Deputy Director of Aviation Safety (Licensing)

SA(L) 1 Planning and development of licensing system for aircrew. Experience and skill requirements for pilots and flight engineers licences, the instrument rating and instructors ratings. Privileges of licences and ratings. Requirements for flight tests for the initial issue of licences. Conversion and validation of non-UK licences.

SA(L)2 Examinations for private, commercial, senior commercial, airline transport pilots' and flight navigators' licences. Meteorology examinations for pilots' and navigators' licences.

SA(L)4 Policy on training and tests for the initial issue and renewal of type ratings for pilots and flight engineers; instrument rating tests. Appointment of authorised examiners to conduct tests on behalf of the Board of Trade. Statement of requirements for inspection and approval of training schools for ab-initio pilots.

Approval of flight simulators.

Arrangements for technical training for Board of Trade operational staff.

Advice on careers in civil aviation.

SA(L)5 Issue and renewal of all aircrew licences.
Clerical arrangements for aircrew licence tests and examinations.

Note: The above terms of reference have been in force since 1963. Since that date the new five year licence and the requirements for approved courses of training have been introduced. A review of professional pilots' qualifications has recently been initiated and the Department has recently taken over from the Guild of Air Pilots and Air Navigators the responsibility for the professional instructor's rating. It has therefore been accepted that the Deputy Directorate should be reorganised. Whilst small staff changes are involved, the reorganisation will essentially provide for:

(*a*) giving the licensing section—(SA(L)5)—the technical staff by which it would be capable of functioning, at least on day-to-day matters, quite independently of the policy sections on which it had previously relied for technical advice and judgements:

(*b*) relieving the licensing policy-making section—(SA(L)1)—of day-to-day matters to enable it to concentrate on issues requiring new policy decisions, and on preparations for the ICAO Personnel Licensing (PEL) Divisional meeting in 1969. At that time the whole range of aircrew licensing matters will be internationally debated and changes will be decided on that will determine policies and practices for a further decade.

(*c*) dividing the section—(SA(L) 4)—into two separate manageable sections, one to be responsible for basic flying training and the other for pilot continuation and "conversion to aircraft type" training in the airlines.

Weather Minima Section

Policy and standards on the establishment of weather minima and amendments to regulations. Preparation of notes for guidance on weather minima. Evaluation of operators' methods and formulae. Advice to Flight Operations Inspector whose duty it is to check specific minima.

Civil Aviation Flying Unit

On behalf of DSA, this Unit witnesses and reports upon the following tests:

> Periodic tests of competency conducted by public transport operators' Check and Training Captains; conversion training conducted by public transport operators' check captains; instrument rating renewal tests conducted by authorised instrument rating examiners; type rating initial flying tests conducted by authorised type rating examiners and tests for the renewal of type rating privileges; training and tests conducted at approved flying training schools.

The Unit also advises DSA, as required, on the content of any of the above training programmes or tests.

APPENDIX B(ii)

(*Chapter 3 refers*)

Board of Trade Flight Examiner/Flight Operations Inspector Class and earlier equivalents

Date	FE (see notes (a) and (b))		FOI (see notes (a) and (b))		Total	
	Complement	*Strength*	*Complement*	*Strength*	*Complement*	*Strength*
30th June 1961	20	19	17	14	37	33
31st December 1961	20	20	17	14	37	34
30th June 1962	20	20	17	17	37	37
31st December 1962	20	19	22	19	42	38
30th June 1963	25	21	22	22	47	43
31st December 1963	25	24	22	20	47	44
30th June 1964	25	22	22	18	47	40
31st December 1964	25	22	22	17	47	39
30th June 1965	25	23	22	17	47	40
31st December 1965	25	21	22	18	47	39
30th June 1966	25	22	33	19	58	41
31st December 1966	29	20	33	21	62	43
30th June 1967	29	19	33	(see note (c)) 26	62	(see note (c)) 45
31st December 1967	29	23	33	(see note (c)) 30	62	(see note (c)) 53
15th January 1968	29	24	33	(see note (c)) 30	62	(see note (c)) 54

Notes: (a) Before the formation of the FE/FOI Class (mid 1965):
(i) Staff Pilots filled the present FE posts.
(ii) Operations Officer Class filled the present FOI posts.

(b) All complements and strengths include:
(i) FE's—Commander and Deputy Commanders CAFU
(ii) FOI's—CFOI or earlier equivalent (DDOps.)

(c) Excludes an Operations Officer I blocking an FOI post.

APPENDIX C

(Chapter 2 refers)

Directorate of Flight Safety : Terms of Reference

The Directorate of Flight Safety is divided into two Deputy Directorates—DDSF(A) and DDSF(B). Their responsibilities are set out below and, because they cover such a wide field, are described section by section for the sake of simplicity:

DDSF(A)

SF(A)1

Policy on certification of aircraft.

Issue of certificates of airworthiness and permits to fly.

Approval of flight manuals.

Co-ordination of Board of Trade and Air Registration Board policy on airworthiness.

Operational aspects of hovercraft.

SF(A)2

Policy regarding safety aspects of flight operations (excluding aircraft performance). Related aircraft crew and equipment matters. Initiation and amendment of relevant legislation.

Policy on operational and safety aspects of Rules of the Air (other than ATC matters).

Advice on the application of the above-named legislation.

(A)3

Development of aircraft operational performance requirements. Initiation and amendment of relevant legislation and advice on its application.

Co-ordination of the airworthiness safety requirements developed by ARB with related operational safety requirements.

Advice to Director of Aerodromes (Technical) on aircraft performance aspects of aerodrome design.

ICAO matters within DDSF(A).

SF(A)4

Supersonic transport aircraft and VTOL projects. Operational performance requirements and initiation and amendment of relevant legislation.

Co-ordination of operational safety requirements for these aircraft with ARB airworthiness requirements.

DSF representation on Anglo-French working groups and committees concerned with SST aircraft.

DDSF(B)

SF(B)1

Initiation of remedial and preventative action arising from civil aircraft accidents and incidents.
Policy on short-term flight safety matters.
Administrative action on civil aircraft accident reports.
Preparation and publication of *Annual Survey of Accidents.*
Maintenance of records of civil aircraft accidents and incidents.

SF(B)2

Special studies of flight safety matters.
Policy on long-term flight safety matters.
Analysis of accident and incident data.

SF(B)3

Participation in a special study of flight deck workload and performance. Advice on operational aspects.

Appendix D

(Chapter 2 refers)

Air Registration Board: Terms of Reference

There are four principal technical departments. The Design and Survey Departments deal respectively with aircraft design and aircraft construction and operation. The Powerplant Department and Flight Test Departments cover the activities implied by their titles.

Design Department

There are six sections which are mainly concerned with co-ordination—

Requirements Section. Development of technical sections of British *Civil Airworthiness Requirements.* Organisation of eight airworthiness requirements co-ordinating committees (industry, operators, Board of Trade etc.). Attendance at ICAO airworthiness meetings.

Design Liaison. Responsible for co-ordination of investigations (design and test) of aircraft (new types, variants, modifications).

Helicopter Section
Hovercraft Section
Concorde Section

As for Design Liaison Section, with additional responsibility for requirement initiation in specialist area.

Foreign Liaison. As for Design Liaison Section, in respect of foreign imports. Also general liaison with foreign authorities on airworthiness procedures. Attendance at ECAC.

The above six sections are supported by six specialist sections:

Electrical, Instrument, Systems and Equipment Section;

Structure Section;

Radio Apparatus Section;

Flight Manual Section;

Advanced Projects Section;

Defects and Accidents Section.

The first five of these initiate requirements in their specialist fields. The first three investigate systems in aircraft or individual items prior to approval. These sections provide members for outside committees (BSI, EUROCAE).

The Defects and Accidents Section makes statistical analyses, and initiates follow-up action.

The Advanced Projects Section studies special problems (automatic landing, powered lift, meteorology). It undertakes flight data recording programming and liaison with research establishments (RAE, NASA).

Flight Test Department

Initiation of handling and performance requirements.

Co-ordination with Board of Trade of complementary airworthiness and operational requirements.

Approval of and participation in constructors' flight test programmes.

Flight test programmes conducted by the ARB monitoring series and periodic flight tests. Examination of flight manuals, pilot and crew notes.

Powerplant Department

Engine Section

Propeller and Gearboxes Section. Initiation of requirements. Investigation of engines, propellers, accessories prior to approval. Investigation of modifications. Establishing and monitoring inspection procedures.

Powerplant Installation Section. Initiation of requirements. Investigation of engine installation, fire prevention, fuel systems, etc.

Survey Department

A large proportion of the Survey Department is based in the area offices or overseas offices. These surveyors undertake supervision of constructors and overhaulers inspection organisation, AOC work, inspection of aircraft, examination of records, licence examinations. Overall control and specialist activities are conducted in Brabazon House. These sections comprise:

Applications and Certification Section. In association with the Board of Trade, arranging issue and renewals of certificates of airworthiness; preparation of International Register.

Approvals Section. Organisation of approval and supervision of firms design and inspection organisations; register of equipment approval.

Maintenance Schedules Section. Examination and approval of maintenance schedules. Keeping maintenance and overhaul manuals under review.

Electrical and Instrument Section. Specialist assistance to area offices, Approvals Section.

Radio Installation Section. Investigation of radio installation.

Technical Publications Section. Preparation of administrative portions of BCAR. Preparation of Civil Aircraft Inspection Procedures.

Personnel Licensing. Establishment of standards of technical examinations. Arrangements for examinations of maintenance engineers, flight engineers and pilots (technical and performance).

APPENDIX E

(*Chapter 3 refers*)

AOC Procedures: Routine Checks

Check A: Loading Performance and Fuel Reserves

Examination of documents relating to past flights for the purpose of determining that:

(*a*) the weight of the aircraft was within C. of A. limits,

(*b*) weight restrictions arising from performance requirements were observed,

(*c*) load distribution was recorded correctly,

(*d*) the weights of all articles and equipment were included on the load-sheet, and that the weights were realistic,

(*e*) fuel carried was adequate and in accordance with the company's operations manual.

Check B: Flying Staff, Training and Testing

Examination of records to determine the adequacy and the validity of the training and testing given to flying staff by an operator, and to determine compliance with flying duty and rest periods.

The documents examined include:

(*a*) conversion training reports and certificates,

(*b*) competence certificates,

(*c*) records of flying duty times and rest periods,

(*d*) records showing the validity of licences, medical certificates and instrument rating certificates.

Check B additionally requires training inspectors to observe ground and air training, and emergency evacuation training to verify that the agreed training manual syllabus is followed.

Check C: Technical Logs and Certificates of Maintenance

Examination of documents relating to post flights for the purpose of determining that:

(*a*) the aircraft was properly maintained and held a valid certificate of maintenance at the time of the flight,

(*b*) technical logs were completed correctly and signed by the aircraft commander,

(*c*) flight times and fuel loads entered in the logs agreed with records maintained by the company's operations department,

(*d*) rectification of defects entered in the log was properly covered by a certificate of compliance signed by a competent person.

Check D : Ramp Inspection

This is a " snap " inspection carried out on aircraft departing from or arriving at aerodromes in the UK and abroad. Emphasis is placed by inspectors on those matters that cannot normally be covered during a base inspection. For example:

(*a*) operator's supervision of traffic staff,

(*b*) arrangements for ensuring that the load is distributed on the aircraft in conformity with the load sheet,

(*c*) adequacy of fuel reserves and accuracy of loadsheet figures,

(*d*) correctness of aircraft loading and the security of loose articles and freight,

(*e*) availability of loading instructions to traffic staff ;

(*f*) physical check of the validity of flight crew licences,

(*g*) validity of flight guides and other documents required to be carried on the aircraft ;

(*h*) adherence to company's altimeter setting procedures.

Check E : Flight Inspection

For this inspection the inspector travels on the aircraft. Aircraft may be boarded anywhere in the world and both long haul and short haul flights are covered.

The main purposes of the flight inspection are:

(*a*) to assess the adequacy of the flight procedures established by the operator, and the facilities provided by him to enable the crew to perform their duties,

(*b*) to examine the standard of flight deck management,

(*c*) to observe the manner in which the crew perform pre-flight and between flight duties,

(*d*) to assess the suitability of rest accommodation provided by the operator for night stops,

(*e*) to assess the effectiveness and completeness of emergency briefing given to passengers.

Check F : Base Facilities and Aircraft Equipment

An operator's base facilities are kept under continuous review. The general adequacy of the organisation, including staffing and accommodation, is reported on. The radio and navigational equipment provided in the aircraft, together with the operations and aircraft libraries, are examined to ensure that they are adequate for the type and the extent of the operations for which the company is certificated, or wishes to be certificated.

Check G : Long Range Navigation

This check applies only to long haul operators and is conducted in two parts—base inspection and flight inspection—by an inspector holding a current unrestricted flight navigator's licence.

The purpose of the base inspection is to assess the adequacy of the organisation, facilities, staffing and equipment provided by the operator for flights on which the carriage of a flight navigator is required. Particular attention is given to the problems associated with oceanic and polar flights.

The primary purposes of the flight inspection are to assess the adequacy of the navigation equipment provided in the aircraft, the adequacy of facilities and procedures established by the operator, and the standard of navigation during the flight.

Check H: Principal Inspector's Annual Review

The purpose of this check is to bring to the notice of the Chief Inspector significant trends and developments, and to verify that the general inspection programme is being achieved and proper standards of supervision maintained.

APPENDIX F

(*Chapter 4 refers*)

Analysis of Accidents

Introduction

1. In this appendix the term " accident " means " notifiable accident " as defined in the Civil Aviation (Investigation of Accidents) Regulations 1951. It does not include minor accidents or " incidents " for the reasons discussed in Appendix H. There were 224 notifiable accidents to public transport aircraft on the British register above 5,000 lb. between 1 January 1955 and 30 June 1967, 181 of which occurred on public transport flights. The figures exclude accidents that occurred while aircraft were in the hands of the manufacturers.

Purpose of the analysis

2. The object of the analysis was to determine the main accident causal factors and to see whether any trends, patterns or recurring factors could be found. Each of the 181 accidents that had occurred during public transport flights was reviewed in turn and consideration given to the possibility of shortcomings on the part of flight personnel, the company, airworthiness, or the Department; consideration was given to weather conditions and to aerodrome or airways deficiencies. The accidents were also related to broad classes of operators and aircraft.

General results of the analysis

3. The results of the analysis are contained in table 1. This table also gives the causal factors classified in groups and these are identified in categories (*a*) to (*q*). It will be seen that there were 59 factors (representing 59 accidents) assessed as indicating a lack of competence on the part of the pilot-in-command; 61 factors (representing 56 accidents) reflecting on airworthiness, i.e. those in which there was some measure of design deficiency, mechanical or material defect, or maintenance deficiency; 37 factors reflecting poor judgment or a lack of pilot discipline and 9 reflecting a lack of crew co-ordination (these together, representing 43 accidents). During the period under review the two Air Corporations together flew approximately the same number of stage flights as the Independent operators. It will, therefore, be seen from table 1 that the record of the Independent operators has almost invariably been inferior to that of the Corporations so far as the factors listed are concerned. The more noteworthy of the various categories in the table will now be considered in greater detail.

Accidents in which poor judgment or lack of pilot discipline was a factor (Category a)

4. Poor judgment or lack of pilot discipline was a factor in 37 of the accidents, 26 of which were suffered by aircraft that were being operated by Independent companies. A review to determine whether there were any trends in these accidents gave the following results:

(*a*) in 16 accidents it would probably have been prudent for the pilot-in-command to have diverted to another airport or to have carried out an overshoot in the prevailing weather conditions because in most cases it appeared that descent was continued below decision height without adequate visual reference to the ground ;

(*b*) in 15 accidents (including two of those above) there was a measure of indiscipline on the part of the pilots involved ; these tended to be diverse in nature and in addition to those features mentioned in (*c*), (*d*), (*e*) and (*f*) below included two infringements of company weather minima and an attempted take-off when the cross-wind component exceeded the laid down limit ;

(*c*) three accidents resulted from failure to adhere to the laid-down approach pattern procedures ;

(*d*) in three accidents the aircraft was overloaded either at take-off or on landing, but on only one occasion did the overloading play any possible part ;

(*e*) two accidents resulted from inadequate pre-flight checks ;

(*f*) two accidents were due to inadequate pre-flight preparation (insufficient fuel).

5. From the above it will be seen that failure to divert or at least overshoot when the destination airport weather was marginal was by far the largest single aspect of accidents involving pilot judgment or indiscipline. The reason for this is not immediately apparent and, indeed, there may be many reasons. It is noted that 11 of the 16 accidents occurred to aircraft operated by independent companies.

6. The annual numbers of accidents assessed as having some element of poor judgment or lack of discipline were as follows:

	Air Corporations	*Independent*
1955	—	2
1956	—	3
1957	—	2
1958	2	3
1959	1	2
1960	3	3
1961	2	2
1962	—	1
1963	—	2
1964	—	3
1965	2	1
1966	1	2
1967 (to 30 June)	—	—

From the foregoing it appears that the incidence of such accidents has been fairly evenly spread throughout the period reviewed.

Deficiencies in crew training (Category b)

7. Twelve accidents were assessed as revealing that crew training had not been adequate. Official reports stated that in five of them there had been inadequate training in dealing with emergencies (three were engine failures, one a hydraulic failure and one an electrical failure in which the engineer was not fully conversant with the aircraft's electrical system). Deficiency in training or need for further training was also mentioned in reports relating to two overruns, an undershoot, a heavy landing in poor visibility, a landing off the side of the runway and a swing off the runway.

Accidents in which pilot competence was a factor (Categories c and d)

8. The review indicated that lack of competence on the part of the pilot-in-command was a factor in 59 accidents. An analysis of these accidents revealed the following:

heavy landings	10
undershoots	10
swings on landing	7
overruns	6
mishandling under emergency conditions ...	5
swings on take-off	4
miscellaneous (factors occurring infrequently such as inadvertent undercarriage retraction, careless taxying and mishandling of fuel systems) ...	17

9. There were also 11 accidents in which the competence of the first officer was a factor. These fell into the following categories:

premature undercarriage retraction	3
undershoots	2
overruns	2
miscellaneous	4

10. The premature undercarriage retractions (three by first officers and one by a pilot-in-command) show the importance of properly co-ordinated flight deck procedures being clearly laid down in operations manuals.

11. The annual numbers of accidents assessed as casting doubt on the competence of the pilots-in-command showed a similar distribution to that given in paragraph 6. BOAC and BEA each had an average of one such accident per year and the Independent airlines an average of three.

Crew fatigue (Category f)

12. Crew fatigue was mentioned as a factor in four official reports on accidents, all of which involved independent operators. It was not possible to make an assessment of the number of occasions on which fatigue might have been a factor in other accidents as the necessary information on flight duty patterns was not recorded during the investigations.

Airworthiness (Categories h, i and j)

13. In the 56 accidents in which airworthiness was a contributory or causal factor, undercarriage and engine failures were the main features. There were 22 accidents involving undercarriage failures, three of which appear

to have been primarily operational, and a further three involving tyre failures. Ambassador and Britannia aircraft each suffered a significant number (five) of undercarriage failures not related to pilot error. Thirteen accidents involved engine failures. Five occurred to Viking aircraft, three of which were fatal.

14. From independent analyses conducted by the Board of Trade and the Air Registration Board, it was concluded that about 30 per cent. of all accident causes were attributable to airworthiness. Since this proportion was much the same whether the aircraft were operated by the Corporations or the Independents, and since the latter showed a higher accident rate than the former, it followed that the airworthiness accident rate for the Independents was proportionately higher. An examination of the individual accidents by the ARB revealed the reason for this. The pattern which emerged was that whereas the airworthiness causes in the case of the Corporations were distributed between several diverse features, the Independents suffered more frequent accidents from landing gear failures and power unit failures. In the period 1957–61 engine failure accounted for nearly two-thirds and landing gear failure for nearly one-third of the Independent operators' accidents attributable to airworthiness. In the period 1962–66, engine failure accounted for about one-quarter and landing gear failure for nearly half of the airworthiness accidents. Structural failure of landing gears is usually associated with fatigue or stress corrosion and both of these are associated with age. It has proved difficult, if not impossible, to predict the onset of these failures. They can occur with "young" aircraft so a policy of fixing in advance a retirement life is not practicable. It is evident that any operator, using older types of aircraft, is more likely to encounter landing gear failure. Once such a failure has occurred, it is then possible to devise methods to prevent the recurrence of that particular failure. A saving grace is that such failures are rarely catastrophic. Nevertheless, landing gear failure is a matter deserving attention and it is considered that present researches to develop more effective methods of fatigue testing need to be pushed ahead. As regards accidents attributable to power unit failure, the higher incidence of troubles experienced by the Independents was associated with the class of aircraft used. The modern aircraft generally offer better engine reliability (due to the use of turbines) and better performance and handling qualities if an engine fails. There was a marked reduction of power unit failure accidents in the more recent five-year period compared with the previous five-year period. This problem is therefore reducing, by virtue of the progressive retirement of the older types of aircraft. The number of accidents attributable to failure to follow approved maintenance procedures was small (four). In addition a further six accidents were partly attributable to other maintenance deficiencies.

Aerodrome deficiencies (Category k)

15. No clear patterns emerged from a study of the 20 accidents in which aerodrome deficiencies appear to have been contributory factors. In four accidents (two of them overseas) mention was made in the reports that approach lights and possibly VASI's* might have helped to prevent them.

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* Visual Approach Slope Indicator

In three instances (two of which were overseas) obstructions were inadequately marked; in one of them better marking might have prevented a closed runway being used for take-off in bad visibility, in another an obstruction light on a ridge on a final approach was not operating (nor was it effectively oriented for the runway used), and in the third snow covered a board marking a dyke about 800 feet from the runway. Failure to pass a deteriorating RVR* to the pilot was a factor in three accidents and two of these were overseas. Other individual accidents were due to such things as striking runway flares, sinking into an inadequately marked runway shoulder, and running into a drain just off the runway.

Fog (Category p)

16. Fog (i.e. meteorological visibility of 1,000 metres and below) was a factor in 23 of the accidents and a breakdown of these accidents according to factors listed in table 1 is given below:

Operator	*Poor judgement or lack of pilot discipline*	*Deficiencies in crew training*	*Pilot competence (pilot-in-command)*	*Pilot competence (first officer)*	*Shortcomings on the part of the company*	*Maintenance deficiency*	*Mechanical or material defect*	*Aerodrome deficiency*
BOAC	1	—	—	—	—	—	—	—
BEA	4	1	4	1	—	—	—	3
Independent ...	9	3	6	—	5	1	1	3
Totals	14	4	10	1	5	1	1	6

Note: the same accident may appear under more than one heading.

17. It will again be seen that poor judgment, indiscipline and lack of competence on the part of the pilot were factors in the majority of these accidents, and from these points of view the record of the Independent operators again appears to be inferior to that of the Corporations. The two common factors in the six fog accidents in which aerodrome deficiencies were contributory factors were failure by ATC to pass information on deteriorating RVR and lack of visual approach guidance; both of which have now been largely rectified insofar as is possible for aerodromes in the United Kingdom.

Heavy rain and aquaplaning (Category q)

18. Consideration was given to accidents in which heavy rain was a factor. There were five such accidents (many others occurred in only light rain) and it is believed that the use of rain repellents on windscreens would have helped to prevent them. Aquaplaning was a factor in six accidents and an *Information Circular* (No. 6/1965) was issued to provide a general description of the phenomenon and its effect on aircraft and also to let pilots and operators know what measures are being taken to solve this problem.

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* Runway Visual Range

Fire

19. In 33 accidents (24 of them fatal) major fires developed on or shortly after impact. Twenty-four of these involved piston-engined aircraft and nine turbine-powered aircraft using kerosene fuel. Minor fires occurred in a further 11 accidents.

Accidents after more than one approach

20. Thirteen accidents occurred after the aircraft concerned had already made one or more approach. In seven instances the accident occurred on the second approach, in four on the third approach and in two on the fourth approach. Three of the accidents took place during attempted overshoot.

Accidents at night

21. Seventy-one of the 181 accidents involving aircraft on public transport flights occurred at night. (Of the additional 43 accidents on non-public transport flights, five occurred at night.) Actual accident rates could not be compared due to the absence of reliable data on the proportion of day and night flying.

22. Thirty-two accidents occurred at night in which the competence of the pilot-in-command was considered to be a factor as compared with 27 by day. Thirteen of the 23 accidents that occurred in fog took place at night. There was no evidence that darkness was a special factor in the occurrence of accidents.

Aircraft involved in more than one accident

23. Eleven aircraft were involved in more than one accident but in no case did it appear that a previous accident had any bearing on a subsequent accident.

Pilots involved in more than one accident, in at least one of which lack of pilot discipline, poor judgment or lack of competence was a factor

24. It was found that:

(*a*) 30 pilots-in-command and three first officers were in two accidents, one of which involved indiscipline, poor judgment or lack of competence;

(*b*) 6 pilots-in-command were involved in three such accidents;

(*c*) 14 pilots, all pilots-in-command, were involved in two accidents in each of which their discipline, judgment or competence was in doubt.

Accidents to older aircraft

25. Special consideration was given to the older aircraft as their safety had been questioned following the DC4 accident on Mt. Canigou on 3 June 1967 and the Canadair C-4 (Argonaut) accident at Stockport on 4 June 1967. The results are reported in Chapter 5 and Appendix J.

Non-public transport accidents

26. The 43 accidents on non-public transport flights were examined to see whether any new trends were evident. It was found that the proportion of accidents that cast some doubt on the pilots' discipline, judgment or

competence and those with airworthiness factors was very similar to that for the public transport accidents, but with a slightly higher incidence of lack of competence. This, however, was to be expected since some of the accidents happened during training. No other trends were evident.

Conclusions

27. In about one-third of the accidents to aircraft engaged in public transport flights lack of competence on the part of the pilot-in-command was considered to be a factor; almost a quarter involved other deficiencies on the part of pilots (poor judgment, lack of discipline or poor crew co-ordination). Airworthiness deficiencies were considered to have been factors in almost a third of the accidents (paragraph 3).

28. An analysis of the accidents by factors concerning shortcomings of the flight crew, the airline company, and airworthiness shows the record of the Independent operators to be inferior to that of the Air Corporations in these respects (paragraph 3 and table 1).

29. An analysis of the 37 accidents that reflected poor judgment or a measure of pilot indiscipline, indicated that in almost half of them it would probably have been prudent for the pilots-in-command to have diverted, or to have carried out overshoots, because of the prevailing weather conditions (paragraphs 4 and 5).

30. An analysis of the 59 accidents in which the competence of pilots was in doubt revealed that the majority were due to heavy landings, undershoots, swings on landing, overruns and mishandling under emergency conditions (paragraph 8).

31. An analysis of the 56 accidents in which airworthiness was a contributory or causal factor revealed that 22 of them were associated with the undercarriage and 13 involved engine failures. Ambassador and Britannia aircraft appear to have been prone to undercarriage failures and Viking aircraft suffered the most engine failures that led to accidents (paragraph 13).

32. Aerodrome deficiencies were contributory factors in 20 accidents but analysis revealed no clear patterns or significantly recurring features.

33. It was found that 14 pilots had been involved in two accidents in each which their discipline, judgment or competence was in doubt aragraph 24).

. Conclusions on the effect of age on aircraft are given in chapter 5 d Appendix J.

TABLE 1

Causal Factors concerning 181 Accidents to British Aircraft above 5,000 lb on Public Transport Flights during the period 1 January 1955 to 30 June 1967

	Crew Factors						Company	Airworthiness Factors			Other Factors						
	Poor judgment or lack of pilot discipline (a)	*Deficiencies in crew training* (b)	*Pilot competence (pilot-in-command)* (c)	*Pilot competence (first officer)* (d)	*Lack of crew co-ordination* (e)	*Crew fatigue* (f)	*Shortcomings on the part of the company* (g)	*Maintenance deficiency* (h)	*Mechanical or material defect* (i)	*Design deficiency* (j)	*Aerodrome deficiency* (k)	*Airways deficiency* (l)	*Shortcomings on the part of the department* (m)	*Special circumstances* (n)	*Turbulence* (o)	*Fog* (p)	*Heavy rain* (q)
BOAC	5	3	10	1	2	0	1	0	6	2	3	0	0	3	2	1	1
BEA	6	2	11	1	0	0	1	4	6	2	7	2	0	6	8	10	0
Independent Operators .	26	7	38	9	7	4	12	6	30	5	10	1	2	4	3	12	4
Totals ...	37	12	59	11	9	4	14	10	42	9	20	3	2	13	13	23	5

Note: The same accident may appear under more than one heading.

APPENDIX G

(*Chapter* 4 *refers*)

A Study of the Safety Levels Achieved by United Kingdom Airlines and Comparisons with Other Countries

The meaning of safety

1. The word safety is defined as freedom from danger or risk and it is precisely in this sense that it is used in the present review. The airline that operates without subjecting its passengers and crews to danger and risk is the safe airline and an assessment of the safety level of an operator can only be made on the basis of the number of occasions on which, in the course of a known amount of flying, the occupants of an aircraft have been subjected to danger.

The need for caution

2. At this point it might appear to anybody who was unfamiliar with the subject that a comparison between the safety levels achieved by different airlines was a simple matter and this is a fallacy which must be repudiated. In fact it can hardly be stated too strongly that considerable thought has to be given to the selection of basic data and great caution exercised in the drawing of conclusions from it, particularly where rates for foreign airlines are involved. The problems are described in detail in the paragraphs that follow as an understanding of them is essential if the situation is to be seen in proper perspective.

The measurement of danger

3. Any fortuitous or unexpected event by which the safety of an aircraft or any person is threatened is the definition of an accident which is given in the Civil Aviation (Investigation of Accidents) Regulations 1951. Under this legislation it is only when an accident is of a certain degree of severity that the operator is legally required to report it and it is then commonly referred to as a 'notifiable accident'. Accidents to aircraft on foreign registers, the way in which they are classified and the rates derived from them are discussed in paragraphs 14 to 19.

4. An accident to an aircraft on the British register becomes notifiable 'if, between the time when any person boards an aircraft with the intention of flight and such time as all persons have disembarked therefrom

- (*a*) any person suffers death or serious injury while in or upon the aircraft or by direct contact with the aircraft or anything attached thereto;
- (*b*) the aircraft receives substantial damage.'

If notifiable accidents are taken as the measure of danger it means that a definition is given to the point at which the occurrence is sufficiently serious to be used in the study and also that all the accidents in the category have been included since it is a legal requirement under the Civil Aviation (Investigation of Accidents) Regulations 1951, for notifiable accidents to be reported and detailed records are maintained at the Board of Trade. On the other hand it must be remembered that the point at which an accident becomes notifiable must, in the end, depend on a subjective opinion even when it is defined in regulations; and although this is unlikely to affect the figures for aircraft registered in the United Kingdom as the decision to class an accident as notifiable is always made by the same organisation, it can be a serious problem when attempting to compare British and foreign safety levels as some countries, such as France, use criteria which differ from our own. (This will be discussed in the paragraphs in which foreign operations are considered.) It must also be remembered that a notifiable accident is defined at its lower, but not at its upper, limit and may be anything from a broken nose-wheel to a major disaster.

Fatal accidents

5. The problem of the subjective opinion when classifying accidents may be overcome by taking the fatal accident as the basic unit since there can seldom be doubt as to whether life has been lost; but by selecting a type of accident that can be defined precisely, the quantity of data available is greatly reduced and this is a serious problem because of the part played by chance in determining whether or not an accident results in fatalities. Over the years it will even itself out, but it is not always the case that there is a long enough period for study to be confident that such an evening-up process has taken place. Waiting for sufficient data and studying longer periods increases the prospect that the accident record is confounded by changes in external circumstances and, perhaps even more serious, delays the analysis of accidents and the drawing of conclusions on which action to reduce them and to improve safety might be based. The problem is illustrated by the case of BOAC which is considered in paragraph 13(*a*) below.

Available data

6. In measuring danger, therefore, there are two basic units available to us, the notifiable accident and the fatal accident. Each has disadvantages, but at present these are the only two units by means of which danger can be assessed with the exception of passenger fatalities which are really another aspect of the fatal accident and will be discussed separately in paragraph 8 below. It is also necessary to bear in mind that the overall picture presented in the tables 1 to 3 is incomplete insofar as those accidents, (commonly known as incidents), which are not sufficiently serious to be classed as notifiable are omitted. If, in the future, it is possible for information about incidents to be collected, such data will provide considerably more material on which to work, but it must be remembered that the subjective opinion on which an occurrence might be classed as an incident could be even more arbitrary than the subjective opinion on which an occurrence in which substantial damage or injury has occurred is at present classed as a notifiable accident.

7. Undoubtedly the soundest method is to consider both notifiable accidents and fatal accidents when making comparisons. Notifiable accidents will probably give a more balanced picture, but if one group of notifiable accidents contains a greater proportion of fatal accidents than another comparable group it will show that the notifiable accidents in that group are more serious and so imply a lower safety level.

Passenger fatalities

8. If the circumstances of accidents are fortuitous, then the number of passengers on board at the time and the number of passengers killed must also be fortuitous and it is not easy to know how much importance should be attached to passenger fatalities as an indication of safety levels. There is, however, one sense in which passenger fatalities are significant apart from being an indication of the severity of the crash. This is from the point of view of the prospective passenger. He wants to know when he starts a journey by air that he can be confident, in the practical every day sense, of completing it alive. He is concerned with what has happened in the past and from this he hopes to form some idea of what is likely to happen in the future. Passenger fatalities are also a measure of danger which is accepted and used internationally.

Relating the risk to the exposure

9. Information about accidents is of little value unless it is related to the amount of flying and this can be measured in three ways; aircraft miles flown, aircraft hours flown and stage flights completed. None of these measures is entirely satisfactory as a criterion of exposure to risk. As most accidents occur at take-off and landing the use of aircraft miles flown as a measure of risk unduly favours the long-haul operator. Similar considerations apply to the use of aircraft hours as a measure of risk with the added factor that it operates to the advantage of slower flying aircraft, compared with faster aircraft. The criterion of stage flights is regarded by the Department as the most satisfactory measure of exposure as it is directly linked to the phases of flight in which most accidents occur. Nevertheless some accidents do occur en route and the use of this criterion is still not ideal and will operate to the advantage of short-haul operations as against operations over longer stages. Owing to the shortcomings of the various criteria it is easy to arrive at invalid conclusions by using one criterion alone. Accident rates based on all these criteria of risk have been used in this review as a basis for calculating rates of different operators so that comparisons can be made between them.

The rates (10-year period: 1 July 1957 to 30 June 1967)

10. The advantages and disadvantages of the accident rates used for the comparison of operators in this part of the review (table 1) will now be considered in detail.

(a) *Notifiable accidents per* 100 *million aircraft miles*
(table 1, column H)

This is a rate which greatly favours BOAC because of the long stage lengths in their operations. During the ten-year period under review it will be seen from table 1, columns A and C that although BOAC flew more aircraft miles than either BEA, or the Independents, the number of stage flights flown was half that of BEA and a quarter that of the Independents. Since the majority of accidents occur during take-off and landing it follows that BOAC was exposed to considerably less risk, although it would be difficult to define this in numerical terms.

(b) *Fatal accidents per* 100 *million aircraft miles*
(table 1, column I)

Again, this is a rate that favours BOAC for the reasons mentioned in the previous paragraph, but another factor is now introduced. It will be seen from columns E and F that notifiable accidents suffered by the Independents were more serious and included a higher proportion of fatal accidents than those suffered by either BOAC or BEA so that this rate affects the Independents adversely.

(c) *Notifiable accidents per* 100 *thousand aircraft hours*
(table 1, column J)

The use of aircraft hours as a measure of exposure to risk brings BOAC nearer to BEA because of the greater proportion of slower aircraft operated by the latter and the additional time spent climbing and descending at speeds below cruising speed in the course of a larger number of stage flights. Columns A and B of table 1 show that BOAC flew considerably more miles in slightly less hours than BEA.

(d) *Fatal accidents per* 100 *thousand aircraft hours*
(table 1, column K)

The situation is similar to (c) above, but the yardstick is unfavourable to the Independents because, as mentioned in (b) above, a higher proportion of the accidents suffered by the Independents were fatal.

(e) *Notifiable accidents per* 100 *thousand stage flights*
(table 1, column L)

This rate is considered by the Department to give the soundest comparison between companies so long as their operations are similar. It is not, however, thought that it should be viewed in isolation. It particularly favours the Independent operators because weight is given to the large number of stage flights carried out by them. The rate also masks the higher proportion of fatal accidents in the notifiable accident figures for the Independent operators. Using this yardstick it will be seen that the Independents have a lower accident rate than BOAC; but not lower than that of BEA, or BEA and BOAC together.

(f) *Fatal accidents per* 100 *thousand stage flights*
(table 1, column M)

This rate, like the previous rate ((e) above), favours the independent operator, but the higher proportion of fatal accidents suffered by the Independents comes to light and the rate for the Independent operators no longer remains below that of BOAC as in (e) above.

(g) *Passengers killed per* 100 *million passenger miles*
(table 1, column N)

This is always a controversial rate for the reasons already stated in paragraph 8 above, but it is not without value and it is accepted internationally. In view of the large number of people who have lost their lives in aircraft operated by independent companies (See table 1, column G) it is a rate which reflects most unfavourably on their operations.

11. Taking the seven rates together, and it is essential that they should be taken together if a balanced conclusion is to be reached, the accident rates for the Independents are higher, with one exception, than those for either BOAC or BEA separately, or BOAC and BEA together. The differences between the Corporations and the Independents in the rates for notifiable and fatal accidents per 100,000 stages are significant in the sense that it is improbable that they have arisen by chance. When the Corporations are looked at separately notifiable accidents per 100,000 stages for BOAC were higher than for BEA and for the Independents, collectively. This does not hold good for fatal accidents.

12. It should perhaps be stated that the yardsticks employed are generally accepted. ICAO, in its *Annual Report* gives the rate criteria used in this review for fatal accidents, but not for notifiable accidents. In the White Paper entitled *Aviation Safety** published in April 1962, 'Passengers killed per 100 million passenger miles' and 'Fatal accidents per 100 million passenger miles' were used for international comparisons and 'Fatal accidents per 100 million aircraft miles' was used for making comparisons between United Kingdom operators. All the fatal rates used in this review are also used in *Annual Surveys of Accidents to Aircraft on the United Kingdom Register* published by HMSO.

The rates (a comparison of two periods of 5 years)

13. A valid criticism of the examination of a ten-year period as a whole is that no account is taken of any change in levels of safety that may have taken place during the period. For this reason the same material has been considered in two consecutive periods of five years (table 2) and comparisons made between the former and the latter using the same criteria as before.

(a) *BOAC*

This is a difficult comparison to make and it shows the problems that can arise if fatal accidents are used as the measure of danger (See paragraph 5 above). Columns H, J and L in table 2 indicate an improvement in accident rates when notifiable accidents are considered, whereas in columns I, K and M, when fatal accidents are considered, a deterioration is shown. Column N, passenger fatalities per 100 million passenger miles, also shows a deterioration.

BOAC did not suffer any fatal accidents in the former period of five years so it was not possible for them to improve on their fatal accident rates. In the latter period they suffered two fatal accidents. In one of these, in which a passenger died after receiving injuries when the aircraft encountered turbulence, the circumstances were such that it is difficult to feel there was any shortcoming on the part of the operator. The other was the accident to the Boeing 707 near Mt. Fuji on 5 March 1966 which resulted from unexpected and abnormally severe turbulence.

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* Cmd. 1695 (HMSO, 2s. 6d.)

In the former period, however, there were two notifiable accidents to BOAC aircraft, which, but for the proverbial hair's breadth, might have been fatal. Over a period of ten years the implications of these four accidents would have evened themselves out (see paragraph 5 above), but in two periods of five years they give an untrue picture. It would be wrong, therefore, to accept the fatal accident rates at their face value and it is likely that the notifiable accident rates reflect a better picture and that there has, in fact, been an improvement in BOAC's level of safety.

(b) *BEA*

Each of the seven rates given (table 2, columns H to N) shows a reduction and there can be little doubt that the level of safety in BEA has risen markedly.

(c) *Independent operators*

Here again there has been an improvement. Six of the seven rates calculated (table 2, columns H, I, J, K, M and N) show a decrease and the one increase, notifiable accidents per 100 thousand stage flights (table 2, column L), is small. On the other hand it must be pointed out that all the rates for the Independents in the second five-year period compare unfavourably with those of BOAC and BEA.

(d) *BOAC and BEA together*

Six of the seven rates calculated (table 2, columns H to M) show improvement. The rate for passengers killed per 100 million passenger miles (column N), shows a slight deterioration no doubt due to the figures for BOAC (see paragraph 13 (*a*) above). It does not however alter the picture.

United Kingdom accident rates compared with those of four other countries and ICAO states as a whole—5-year period 1962 to 1966

14. A comparison of accident rates on scheduled airline services achieved by the United Kingdom, United States of America, Australia, France, and ICAO member states as a whole in the 5-year period 1962–1966 is shown at table 3. This table has been compiled from official statistics published by the individual States and/or by ICAO. The rates pertaining to scheduled services only were chosen as the basis for comparison because insufficient information is published internationally on the operating statistics for non-scheduled operations to enable "like-with-like" comparisons to be made.

The yardsticks

15. The same criteria have been used for comparison as in tables 1 and 2; namely, notifiable and fatal accidents per 100 million aircraft miles, per 100,000 aircraft hours and per 100,000 stage flights, and passengers killed per 100 million passenger miles.

Problems relating to foreign accident statistics

16. Once again there is a need for caution and before the individual rates can be compared in table 3, certain modifying factors require explanation. These are:

(*a*) The internationally accepted definition of a notifiable accident is one in which any person is killed or seriously injured, or the aircraft sustains substantial damage between the time any person boards the aircraft with the intention of flight and the time all such persons have disembarked. The interpretation of what constitutes substantial damage, however, appears to vary from State to State. In France, for instance, for an accident to be included in the Bureau Veritas accident statistics, the damage sustained must be not less less than 10 per cent of the value of the new machine. Using this yardstick, a number of the accidents now classified as notifiable under United Kingdom regulations would cease to be so and consequently the accident rates derived would be markedly improved. Any international comparison of rates for notifiable accidents must therefore be made with this in mind.

(*b*) The numbers of fatal accidents published in ICAO *Annual Reports* are those fatal accidents on scheduled services in which one or more passengers were killed. The numbers exclude fatal accidents on scheduled freight services and fatal accidents in which only crew members were killed. United Kingdom accident rates calculated on this basis have been included in table 3 as "UK to ICAO standard" in order to provide a valid comparison between United Kingdom and all ICAO States' fatal accident rates.

The rates

17. Bearing in mind the modifying factors explained in paragraph 16, table 3 shows that, for notifiable accidents, the United Kingdom accident rates achieved over the 5-year period 1962–1966 were inferior to those achieved by the United States, Australia, and France whether calculated on an aircraft miles, aircraft hours, or a stage flights basis.

18. The United Kingdom fatal accident rates and the number of passengers killed per 100 million passenger miles flown show roughly the same picture, with one exception. The French fatal accident rate per 100,000 stage flights and number of passengers killed per 100 million passenger miles are somewhat higher than those for the United Kingdom. The French rates, however, relate only to the scheduled services operated by three major airlines, whereas the United Kingdom figures include the operating statistics of many smaller companies, so that these comparisons are not really on a "like to like" basis. The French rates (table 3, line 4) and those of the Corporations (table 2, line 6) are more comparable although operating statistics for the Corporations contain an element of non-scheduled services. It will be seen that the latter rates do not differ widely.

19. The United Kingdom fatal accident rates (UK to ICAO standard) compared with the rates achieved by ICAO member states as a whole are lower in all but one instance i.e. passengers killed per 100 million passenger miles, where the United Kingdom rate is slightly higher than the world rate.

General conclusions

20. There are two main conclusions to be drawn from the rates for United Kingdom operators given in tables 1 and 2. The first conclusion is that the safety levels of all sectors of United Kingdom public transport operations have improved over the past ten years. In the case of BOAC the evidence may be insufficient to show this, but the fact that BOAC's record is good

cannot be questioned. The second conclusion is that the accident rates of the Independent operators in each of the five-year periods, as in the whole ten-year period, were significantly higher than those of the combined Corporations and their safety levels were lower.

21. Comparisons between United Kingdom and foreign operators, table 3, have to be qualified in so many ways that it is difficult to reach positive conclusions, but it does seem that the rates for the United Kingdom may indicate a lower level of safety than those for the United States or Australia. The United Kingdom rates, however, indicate that the United Kingdom levels of safety are probably of the same order and may be better than those for ICAO member states as a whole.

APPENDIX G: TABLE 1

Accident Rates for United Kingdom Operators: 10-year period, 1 July 1957 to 30 June 1967

	A	B	C	D	E (*see note* 2)	F	G	H	I	J	K	L (*see note* 2)	M	N
Operator	Aircraft miles flown	Aircraft hours flown	Stage flights flown	Passenger miles flown	Notifiable accidents	Fatal accidents	Passengers killed	Notifiable accidents per 100 million aircraft miles	Fatal accidents per 100 million aircraft miles	Notifiable accidents per 100,000 aircraft hours	Fatal accidents per 100,000 aircraft hours	Notifiable accidents per 100,000 stage flights	Fatal accidents per 100,000 stage flights	Passengers killed per 100 million passenger miles
	(*Millions*)	(*Thousands*)	(*Thousands*)	(*Millions*)	(*Number*)	(*Number*)	(*Number*)							
1 BOAC 1957–1967 ...	620·5	1716	457	32587	23 (17)	2	114	3·71	0·32	1·34	0·12	5·03 (3·72)	0·44	0·35
2 BEA 1957–1967 ...	408·8	1829	1369	19009	40 (28)	7	100	9·78	1·71	2·19	0·38	2·92 (2·05)	0·51	0·53
3 BOAC + BEA 1957–1967 ...	1029·3	3545	1826	51596	63 (45)	9	214	6·12	0·87	1·78	0·25	3·45 (2·46)	0·49	0·41
4 Independents 1957–1967 ...	513·9	2345	1995	20729	80 (74)	24	620	15·57	4·67	3·41	1·02	4·01 (3·71)	1·20	2·99
5 All operators 1957–1967 ...	1543·2	5890	3821	72325	143 (119)	33	834	9·27	2·14	2·43	0·56	3·74 (3·11)	0·86	1·15

Notes:

1. Operating statistics for the independent operators prior to 1961 are estimates provided by the Statistics Division of the Board of Trade.
2. The figures in column E and accident rates in column L which are in brackets relate to notifiable accidents when 'minor' accidents are excluded. Minor accidents include taxying accidents, accidents to third parties, and turbulence accidents involving no aircraft damage.

APPENDIX G: TABLE 2

Accident Rates for United Kingdom Operators: two 5-year periods

Comparison of 5-year period 1 July 1957 to 30 June 1962 with 5-year period 1 July 1962 to 30 June 1967

	Operator	A	B	C	D	E (see note 2)	F	G	H	I	J	K	L (see note 2)	M	N
		Aircraft miles flown (Millions)	Aircraft hours flown (Thousands)	Stage flights flown (Thousands)	Passenger miles flown (Millions)	Notifiable accidents (Number)	Fatal accidents (Number)	Passengers killed (Number)	Notifiable accidents per 100 million aircraft miles	Fatal accidents per 100 million aircraft miles	Notifiable accidents per 100,000 aircraft hours	Fatal accidents per 100,000 aircraft hours	Notifiable accidents per 100,000 stage flights	Fatal accidents per 100,000 stage flights	Passengers killed per 100 million passenger miles
1	1957–1962 ... BOAC	278·0	903	221	11493	14 (13)	0	0	5·04	0	1·55	0	6·33 (5·88)	0	0
2	1962–1967 ...	342·5	813	236	21093	9 (4)	2	114	2·63	0·58	1·11	0·25	3·81 (1·69)	0·85	0·54
3	1957–1962 ... BEA	180·6	900	635	6174	23 (16)	6	70	12·74	3·32	2·56	0·67	3·62 (2·52)	0·94	1·13
4	1962–1967 ...	228·2	928	734	12835	17 (12)	1	30	7·45	0·44	1·83	0·11	2·32 (1·63)	0·14	0·23
5	1957–1962 ... BOAC + BEA	458·6	1803	856	17667	37 (29)	6	70	8·07	1·31	2·05	0·33	4·32 (3·39)	0·70	0·40
6	1962–1967 ...	570·7	1741	970	33928	26 (16)	3	144	4·56	0·53	1·49	0·17	2·68 (1·65)	0·31	0·42
7	1957–1962 ... Independents	219·2	925	993	5947	39 (36)	15	279	17·79	6·84	4·22	1·62	3·93 (3·63)	1·51	4·69
8	1962–1967 ...	294·7	1420	1002	14782	41 (38)	9	341	13·91	3·05	2·89	0·63	4·09 (3·79)	0·90	2·31
9	1957–1962 ... All operators	677·8	2728	1849	23614	76 (65)	21	349	11·21	3·10	2·79	0·77	4·12 (3·52)	1·14	1·48
10	1962–1967 ...	865·4	3161	1972	48710	67 (54)	12	485	7·74	1·39	2·12	0·38	3·40 (2·74)	0·61	1·00

Notes:

1. Operating statistics for the Independent operators prior to 1961 are estimates provided by the Statistics Division of the Board of Trade.

2. The figures in column E and accident rates in column L which are in brackets relate to notifiable accidents when ' minor ' accidents are excluded. ' Minor ' accidents include taxying accidents, accidents to third parties and turbulence accidents involving no aircraft damage.

Appendix G: Table 3

Accident Rates for Foreign Operators—Comparison with United Kingdom Figures
Scheduled Services only, 1962–1966

	State	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		Aircraft miles flown	Aircraft hours flown	Stage flights flown	Passenger miles flown	Notifiable accidents	Fatal accidents	Passengers killed	Notifiable accidents per 100 million aircraft miles	Fatal accidents per 100 million aircraft miles	Notifiable accidents per 100,000 aircraft hours	Fatal accidents per 100,000 aircraft hours	Notifiable accidents per 100,000 stage flights	Fatal accidents per 100,000 stage flights	Passengers killed per 100 million passenger miles
		(Millions)	*(Thousands)*	*(Thousands)*	*(Millions)*	*(Number)*	*(Number)*	*(Number)*							
1	United Kingdom... *(see note 1)*	644·7	2312·6	1642·4	32785	43	7	250	6·67	1·09	1·86	0·30	2·62	0·43	0·76
2	United States ... *(see note 2)*	6181	19244·3	19943·7	302300	282	36	770	4·56	0·58	1·47	0·19	1·41	0·18	0·25
3	Australia ... ... *(see note 3)*	387·3	1602·2	1140·2	14387	11	1	20	2·84	0·26	0·69	0·06	0·96	0·09	0·14
4	France ... ... *(see note 4)*	383·3	1175·7	640·8	22090	13	3	187	3·39	0·78	1·11	0·26	2·03	0·47	0·85
5	All ICAO members *(see note 5)*	11760	42000	35800	543000	N/A	131	3732	N/A	1·11	N/A	0·31	N/A	0·37	0·69
6	UK to ICAO standard *(see note 6)*	644·7	2312·6	1642·4	32785	43	5	250	6·67	0·78	1·86	0·22	2·62	0·30	0·76

Notes:

1. United Kingdom statistics are taken from *Annual Surveys of Accidents to Aircraft.*
2. United States statistics are for certificated route carriers only and are taken from CAB *Annual Resumes of Accidents* and ICAO *Digest of Statistics.*
3. Australian statistics are taken from *Annual Civil Aviation Reports* and ICAO *Digest of Statistics.*
4. French statistics are for Air France, UTA, and Air Inter only and are taken from *Bulletin Technique du Bureau Veritas* and ICAO *Digest of Statistics.*
5. All ICAO members statistics are taken from ICAO *Digest of Statistics* and *Annual Reports.* It should be noted that fatal accident numbers and rates exclude accidents in which crew members only were killed.
6. United Kingdom figures for fatal accidents and rates in line 6 are shown on the same basis as for all ICAO members.
7. N/A = not available.

APPENDIX H

(Chapter 4 refers)

Notification of Aircraft Accidents and Incidents

Introduction

It is generally accepted that the investigation of aircraft accidents plays an important part in maintaining safety in the air. Once the causes of accidents have been established and remedial action taken, detailed studies and analyses often bring to light dangers that have not formerly been appreciated and in this way accidents can be prevented in the future. What is not always clear, however, is the point at which an occurrence becomes sufficiently serious to be of use for study and this is one of the difficulties which has to be faced when legislation relating to the notification of accidents and incidents is being considered.

International position

2. Article 26 of the Chicago Convention on International Civil Aviation established the need for accidents to be investigated. Annex 13 to the Convention defines an aircraft accident as:

> "An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:
>
> (*a*) any person suffers death or serious injury as a result of being in or upon the aircraft or by direct contact with the aircraft or anything attached thereto, or
>
> (*b*) the aircraft receives substantial damage".

3. It is provided that the country in which the accident occurs must institute an inquiry into the accident and notify the country in which the aircraft was registered and the country in which it was manufactured as soon as possible. There is no provision for the notification of other lesser accidents or of incidents that may endanger safety but the importance of investigating these occurrences is stressed in ICAO's *Manual of Aircraft Accident Investigation.* The Accident Investigation Division of the Organisation has also drawn attention to the importance of obtaining information on incidents in order to prevent accidents and has recommended that such information should be made available to the countries concerned.

United Kingdom legislation

4. In this country an aircraft accident as defined in the Civil Aviation (Investigation of Accidents) Regulations 1951 "includes any fortuitous or unexpected event by which the safety of an aircraft or any person is threatened". It differs from the international definition in that it covers those minor accidents and incidents that ICAO excludes, but which it nevertheless considers to be important for the purpose of accident prevention. The United Kingdom Regulations, however, use the ICAO definition of an accident to define accidents that must be notified. The Regulations also provide that all types of accident may be investigated at the discretion of the Chief Inspector.

United Kingdom practice

5. In practice, a formal investigation, followed by a formal report is normally made in the case of the majority of public transport accidents that are notified. Follow-up action is taken by the Directorate of Flight Safety to prevent, so far as possible, a repetition of any particular type of accident and causal factors are reviewed in the annual Survey of accidents and analysed to determine patterns or trends affecting flight safety.

6. So far as other accidents, commonly known as incidents, are concerned it is the present policy of the Board of Trade to encourage airline operators to establish their own machinery for the internal reporting of occurrences and for investigation and follow-up action within their own organisation. The policy is in line with the advice contained in the ICAO *Manual of Accident Investigation* which, while stressing the importance of collecting information on incidents and investigating them, suggests that investigation may best be done by operators with the active encouragement of the States concerned.

7. Inter-airline exchange of information useful to safety arising from their investigations is made through the Government-sponsored Flight Safety Committee on which the Board of Trade is represented. In practice, a number of the smaller airlines are not members of the Committee and do not participate in the exchange of information and some airlines that do participate do not themselves contribute information although they receive it. Information is contributed on a confidential basis because it is not in the interests of airlines to publicise information that would invite a loss of confidence in their operations.

8. The Flight Safety Committee does not employ specialist staff and does not undertake the analysis of accident and incident information on a long-term basis for accident prevention purposes. This is a function of the Board of Trade's Directorate of Flight Safety, but the confidential information on aircraft incidents circulated among airlines cannot be openly reviewed by the Department nor can it be published in the annual Survey of accidents.

9. In addition to encouraging airlines to collect, investigate and disseminate information on minor accidents and incidents, the Board of Trade has established a number of voluntary incident reporting systems. The systems for reporting air misses (near collisions between aircraft in flight) and bird strikes have been widely publicised. About 120 air miss reports and 140 bird strike reports are received annually. In addition, airport authorities are encouraged to report incidents that occur at or near their aerodromes on a form specially prepared and provided by the Department. Some airports return forms frequently, some rarely, and others not at all. About 100 such reports are received each year. Information from all these reports is analysed by the appropriate branch in the Board of Trade and any lessons applied for the prevention of accidents. It is thought that most of the bird strikes that occur and many of the air misses that are observed are in fact reported. It is believed, however, that reports of incidents received from airports represent only a small part of the total number of incidents other than bird strikes and air misses that occur. So far as

incidents affecting the airworthiness of aircraft are concerned, the Air Registration Board operates a voluntary system of reporting through their own surveyors in the field. This system appears to work well but, again, the number of occurrences that go unreported is not known and useful information must frequently be lost.

Airworthiness data recording programme

10. Incidents on which information might not otherwise be available are sometimes brought to light as a result of a preliminary study known as the Civil Aircraft Airworthiness Data Recording Programme (CAADRP). It is made possible by a contract placed with BOAC and BEA under which these airlines carry, in some of their jet aircraft, special flight recorders in addition to those required by law. The recorders are fitted in a small number of VC 10 and Trident aircraft.

11. In this way a systematic study is made for airworthiness purposes of the normal operational flight of civil transport aircraft. From time to time, unusual occurrences called " special events " are noted. When these events hold lessons that could be applied to day-to-day operations of jet aircraft the information is immediately made available to airlines. Two examples of " special events " that enabled worthwhile action to be taken may be of interest.

In the first it was discovered that some pilots during take-off were not adhering to the correct speed laid down for rotation (V_R) and in the second, it was found that others were using flaps during the let-down in a way which was not in accordance with the purpose for which the flaps were designed.

12. The results of the study, which is continuing, indicate that the use of special flight recorders offers a very effective means of accumulating information on aircraft incidents and could be of great value for accident prevention purposes, particularly as it records the sort of information which is not likely to be obtained from other sources. Serious problems of cost and of organising the processing and interpretation of data will, however, arise if what is at present an experiment is expanded for use on a large scale.

Practice in the United States and Australia

13. The procedures for notifying accidents in the USA and Australia are of interest since the accident rates for these countries, as shown in appendix G, appear to be better, for scheduled services, than those of the United Kingdom. It may therefore be appropriate to consider the lessons that might be learnt from experience in these countries.

14. In the United States immediate notification is required by law when :

(*a*) as a result of the operation of an aircraft any person (occupant or non-occupant) receives fatal or serious injury or any aircraft receives substantial damage,

(*b*) aircraft collide in flight,

(*c*) the following in-flight hazards are experienced :

    (i) fire
    (ii) rapid decompression requiring emergency action
    (iii) unwanted or asymmetrical thrust reversal
    (iv) flight control system malfunction or failure
    (v) inability of any required flight crew member to perform his normal flight duties as a result of injury or illness.

(*d*) an aircraft is overdue and is believed to have been involved in an accident.

15. In Australia the definition of an aircraft accident follows that of ICAO, and is the same as the United Kingdom definition of a "notifiable accident". In addition, Australian legislation gives precise definition to an "incident" as an occurrence which takes place either on the ground or in flight in which:

(*a*) the aircraft suffers damage or a person suffers injury in circumstances other than those specified in the definition of an accident,

(*b*) the aircraft has a forced landing,

(*c*) the aircraft lands at a scheduled aerodrome in an unairworthy condition,

(*d*) the aircraft is compelled to land at the aerodrome of departure without completing the scheduled flight,

(*e*) the aircraft lands owing to conditions which make the continuance of the flight inadvisable,

(*f*) the position of the aircraft becomes unknown for any period, or

(*g*) the safety of the aircraft or its occupants or of any other person is jeopardised.

16. Australian legislation requires both accidents and incidents to be notified to the Director General of Civil Aviation. In the year 1965–66 more than 5,000 incidents were reported. The number of these occurrences which were investigated is not known, but information on all of them was available for analysis and accident prevention. The annual report of the Australian Department of Civil Aviation for 1965–66 comments that "to a large extent the very high level of aviation safety achieved in this country can be attributed to its 20-year-old incident reporting and investigation system which has revealed many unsafe trends enabling prompt action to prevent accidents".

Need for review of United Kingdom practice

17. It has been shown in appendix G that the levels of safety of airlines in this country, although thought to be of the same order as those of France and of ICAO member states as a whole, are probably below those of the USA and Australia. All possible steps are taken to prevent the recurrence of serious accidents by investigating them and carrying out follow-up action when they occur. However, the introduction of aircraft such as the Boeing 747 in which a large number of passengers is likely to be at risk at any one time, emphasises the need to prevent accidents, quite apart from the high cost of such aircraft. The Concorde, although smaller, is another aircraft in which cost will be an important factor.

Conclusions

18. Timely information on all occurrences that endanger aircraft offers a valuable guide to methods of preventing accidents, but the present system in this country for collecting and acting on such information should be improved. It relies, to a large extent, on the voluntary exchange of information among some, but not all, airlines and on the follow-up action taken by individual companies. Apart from air misses and bird strikes, the voluntary system for reporting incidents to the Board of Trade is infrequently used by some operators and the information which is made available by them is often incomplete and out-of-date.

Recommendations

19. It is recommended that steps be taken to ensure that all such incidents are brought to light by operators and used by them for accident prevention purposes.

20. It is also recommended that incidents should be brought to the attention of the Director of Flight Safety by operators, for the purpose of safety analysis.

APPENDIX J

(*Chapter 5 refers*)

The Effects of Age of Aircraft on Safety

Learning period

1. Reference is made in chapter 5 to the long 'learning period' following the introduction of a new type of aircraft. One type, which is now well-established, experienced 30 accidents in its first million hours, 20 accidents in the second million hours and 10 accidents in each million hours thereafter. Thus as much as 2 million hours can elapse before the full safety potential of a type is realised. If 100 aircraft of a type are built, and each flies 3,000 hours a year the learning period lasts over 6 years.

Examination of accident records

2. The accident records of 6 older and 6 newer types have been examined to study any trends with age.

The date of introduction into UK service for the 12 types are as shown (a few of the American types were used earlier in the USA):

1943 Dakota
1946 Constellation
1946 Viking
1947 DC 4
1949 Argonaut
1951 Ambassador

1952 Viscount
1956 Britannia
1957 DC 6/7
1958 Comet 4
1960 Vanguard
1960 Boeing 707

3. The total number of notifiable and fatal accidents and hours flown are shown in table I for the period 1 July 1955 to 30 June 1967.

4. Table I also shows that some of the older types—Dakota, Constellation and Argonaut—have better than the overall average rate for notifiable accidents. The newer types generally show a more consistent pattern but the Britannia, one of the oldest of the new types, stands out well.

Taking the aircraft in order of age, and examining the accident record each individual type over the last 12 years, the various trends can be rned as follows:

Dakota:	Since 1964 (21 years after entering service) the accident rate has worsened, although there is no evidence of deterioration in the airworthiness of the actual aircraft.
Constellation:	The sample is too small to show a trend.

Viking:	Since about 1960 (14 years after entering service) the accident rate has worsened and this record shows some pattern of power plant failure.
DC 4:	The sample is too small to show a trend.
Argonaut:	The sample is too small to show a trend.
Ambassador:	The accident rate has remained steady with a pattern of undercarriage failure.
Viscount:	The accident rate has improved throughout the last 12 years.
Britannia:	Since about 1961 (after 9 years in service) a slight worsening trend has occurred.
DC 6/7:	The sample is too small to show a trend.
Comet 4:	The accident rate has improved throughout the 9-year period in service.
Vanguard:	The sample is too small to show a trend.
Boeing 707:	The accident rate shows signs of worsening in the last year or two, after about 6 years in service.

6. Of these aircraft for which the sample is big enough to show trends, worsening of accident rate occurred after 21, 14, 9 and 6 years, while improvements occurred, in two cases, over 12 years and 9 years. It is evidently difficult to generalise.

7. It seems unlikely that these various trends are directly associated with age. There are indications that the variations of rates have more to do with changes in the nature of the operation than with the aircraft themselves.

8. For most of the types studied the number of fatal accidents is too small to make reliable comparisons. A review of the fatal accidents involving the older types of aircraft indicated no clear patterns. The possible exception was that the Viking had three engine failures that led to fatal accidents (a further two non-fatal accidents were due to engine failure). Numerically, the Dakota, of which a large number (about 60) are still in service, suffered the greatest number (8) of fatal accidents; these tended to be mainly operational in nature. Two of them reflected deficiencies in Board of Trade requirements and these have since been rectified by amendments to the Air Navigation Order relating to the minimum standards for aerodrome service and aircraft radio navigation equipment for public transport flights. Lack of pilot discipline and pilot competence were predominant factors but these were not features related only to the older aircraft.

TABLE 1

Period 1 January 1955 to 30 June 1967

(Rates per 100,000 hours)

	Hours	Accidents		Rates	
		Notifiable	Fatal	Notifiable	Fatal
	Thousands				
Dakota	1,081·7	25	8	2·32	0·74
Constellation	131·8	2	1	1·54	0·77
Viking	307·1	17	4	5·66	1·33
DC4	132·0	6	2	4·62	1·54
Argonaut	207·8	4	3	2·00	1·50
Ambassador	226·6	10	1	4·35	0·45
Total	2,087·0	64	19	3·06	0·91
Viscount	1,474·1	39	6	2·65	0·41
Britannia	854·0	14	4	1·6	0·47
DC6/7	242·2	5	1	2·06	0·41
Comet 4	594·7	15	1	2·5	0·17
Vanguard	230·9	6	1	2·6	0·44
Boeing 707	457·8	9	2	1·97	0·44
Total	3,853·7	88	15	2·29	0·39
Total of all	5,940·7	152	34	2·56	0·57

TABLE 2

Period 1 July 1955 to 30 June 1961

(Rates per 100,000 hours)

	Hours	Accidents		Rates	
		Notifiable	Fatal	Notifiable	Fatal
	Thousands				
Dakota	712·8	10	4	1·40	0·56
Constellation	104·1	0	0	0	0
Viking	261·7	12	3	4·60	1·15
DC4	61·7	0	0	0	0
Argonaut	186·7	2	2	1·07	1·07
Ambassador	117·3	5	1	4·26	0·85
Total	1,444·3	29	10	2·02	0·69
Viscount	724·8	24	4	3·32	0·55
Britannia	349·5	4	1	1·14	0·29
DC6/7	148·8	2	0	1·34	0
Comet 4	161·4	7	0	4·37	0
Vanguard	3·4	0	0	0	0
Boeing 707	32·5	2	0	6·11	0
Total	1,420·4	39	5	2·7	0·35
Total of all	2,864·7	68	15	2·4	0·52

TABLE 3

Period 1 July 1961 to 30 June 1967

(Rates per 100,000 hours)

	Hours	Accidents		Rates	
		Notifiable	Fatal	Notifiable	Fatal
	Thousands				
Dakota	368·9	15	4	4·08	1·08
Constellation	27·7	2	1	7·25	3·60
Viking	45·4	5	1	11·00	2·20
DC4	70·3	6	2	8·55	2·84
Argonaut	21·1	2	1	9·46	4·74
Ambassador	109·3	5	0	4·57	0
Total	642·7	35	9	5·5	1·41
Viscount	749·3	15	2	2·00	0·27
Britannia	504·5	10	3	2·00	0·6
DC6/7	93·4	3	1	3·22	1·07
Comet 4...	433·3	8	1	1·88	0·23
Vanguard	227·5	6	1	2·77	0·45
Boeing 707	425·3	7	2	1·65	0·47
Total	2,433·3	49	10	2·01	0·41
Total of all ...	3,076·0	84	19	2·41	0·61

APPENDIX K

Aviation Safety in Relation to the Structure of the Air Transport Industry

The following comment was submitted to the Board of Trade by myself on the 1 August 1967 following the announcement by the President that he had decided to institute an inquiry into the civil air transport industry (the Edwards Committee).

Obviously it suffers from the shortcomings of any such general observation. Nevertheless, I have not seen cause subsequently to alter my views on the main contention and the comment is repeated here, without amendment, since it is closely related to the subject of this Review.

> "A marked improvement in air safety is unlikely unless the smaller operators are grouped together to form larger units.
>
> This suggests that a *rationalisation* of the UK airline industry is necessary. The basic concept is capable of further development, of course.
>
> This conclusion is based upon the following considerations:
>
> > The Independent Air Operators taken as a whole have a poor air safety record.
> >
> > An examination of the records regarding all Air Operators' Certificates is disquieting. Of the 85 certificates issued since 1961, only 39 remain current. Of the other 46, 18 were revoked by the Director of Aviation Safety and 9 were surrendered following Company liquidation. (These are provisional figures and subject to later verification.*) This presents a sorry picture of general instability and financial weakness. Even worse is the realisation that over 20 per cent. of the certificates were revoked by the Director of Aviation Safety due to failure to meet the safety requirements.
>
> The Air Registration Board is concerned at the large-scale re-equipment plans of certain operators in relation to the limited forward planning of engineering maintenance requirements.
>
> The limited financial resources of a number of operators in relation to existing commitments and planned developments have an adverse effect on air safety. Economic pressures limit expenditure on engineering maintenance and aircrew training in particular. These same economic pressures are conveyed down the line from management to the aircraft commander on the flight deck.
>
> The civil passenger transport aircraft of today is a highly sophisticated and expensive vehicle. For the proper utilisation of these aircraft and the crews that fly them a substantial organisation and solid support are required. Aircraft maintenance to the high standards essential for air

---

Note

* corrections to the figures quoted in this letter are shown in parenthesis against the original figures as follows:

85 (88)	39 (42)
46 (46)	18 (20)
9 (9)	20%(22)

safety can only be undertaken with the right facilities: modern hangar accommodation: complex and expensive test rigs: a multiplicity of highly specialised tools and equipment: a comprehensive organisation with its associated documentation. Similarly, the proper training and checking of flight crews requires good organisation and modern training aids. The flight simulator, for example, has become an almost indispensable training requirement.

The 'man and a boy' methods of yesterday have no part in the airline operation of today. The technological development of the aircraft demands a corresponding growth in the organisation necessary to exploit its potential. Inevitably, this determines the *size* of the operator in terms of finance, facilities, organisation and staff.

If civil aviation in the United Kingdom is to achieve its proper development and rate of growth, commensurate with air safety, the operating units must be of optimum size. There is good reason to think that the optimum size is appreciably larger than that of many present day operators.

Finally, it is not unreasonable to suggest that the British public may be paying a high price in terms of air safety for whatever benefits might derive from the existence of a relatively large number of smaller operators."

APPENDIX L

(Chapter 10 refers)

Aviation Safety and the Air Transport Licensing Board

1. The Air Transport Licensing Board is the regulatory body which controls to a large extent the pattern of air operations by the United Kingdom airlines. In so doing it has, in my opinion, a marked influence on many aspects of aviation safety.

2. I believe the Board themselves take the view that they are specifically excluded by the Civil Aviation (Licensing) Act 1960, Section 2(4) from a consideration of aviation safety matters.

(For convenience, the relevant extracts from the Civil Aviation (Licensing) Act 1960 and from the Air Navigation Order 1966, Article 4 (which specifies the conditions of issue of the Air Operator's Certificate) are attached.)

3. However, Section 2(2) of the Act requires that the Board should have regard to the applicant's financial resources when satisfying themselves as to his competency to operate aircraft for the purposes for which he seeks an air service licence.

4. Now it seems to me quite impossible for the Board to judge the adequacy of an applicant's financial resources without being fully aware of *all* the financial implications of the particular air service. This would involve a thorough understanding of the many varied aspects of air transportation, would reqnire highly specialised technical knowledge of operational, engineering and commercial matters and the ability to assess the related costs. In all of these considerations safety matters could not be excluded.

5. I do not believe that the Air Transport Licensing Board, with the support of the Secretariat, possesses the capability to undertake examinations of this complexity, irrespective of the number of applications involved.

6. There would appear to be strong justification for providing the ATLB with the necessary capability to carry out thorough investigations of the financial viability of operators, preferably on a continuous basis.

7. It is of interest to note that in the United States the Federal Aviation Act of 1958, Section 407, specifies in more precise terms than the equivalent United Kingdom legislation the procedure whereby an operator supplies information as to his financial viability. It would seem that the Civil Aeronautics Board is able to obtain *any* information under oath from any carrier at *any time*. Relevant extracts are attached.

8. It will be seen from the suggested re-organisation plan at appendix N that an Economic Advisory Service is advocated to advise the Air Transport Licensing Board on the economic aspects of engineering and operational matters.

9. Chapter 6 of the Review Report states : "It is essential that the available finance shall match the scale of operation. The lack of adequate financial resources has a significant and far-reaching effect on environment and morale, leading inevitably to some effect on operational standards."

10. There can be no doubt that the present unsatisfactory situation, whereby an operator's financial resources in relation to present and proposed operations are not fully investigated, represents a most serious weakness in the aviation safety organisation and must be remedied without delay.

11. It will be obvious from its terms of reference that the Edwards Committee will need to give close attention to this matter during its deliberations.

Extracts from The Civil Aviation (Licensing) Act 1960

Section 2(1). Any application to the Board for the grant of an air service licence shall contain such particulars as may be prescribed; and, subject to the provisions of this section and of any relevant regulations under section five of this Act, the Board may at their discretion, after consulting with such persons, if any, as may be prescribed, either refuse the application or grant the applicant an air service licence for any air transport service or other purpose specified in the licence (being a service or other purpose proposed in the application with such modifications, if any, as the Board may think fit) for such term and subject to such conditions, if any, of the prescribed descriptions as may be so specified.

Section 2(2). In exercising their functions under this section the Board shall consider in particular—

(*a*) whether they are satisfied that, having regard in particular to his experience and financial resources and, subject to sub-section (4) of this section, to his ability to provide satisfactory equipment, organisation and staffing arrangements, and having regard also to any contravention in respect of aircraft operated by him of the provisions of section one of this Act, the applicant is competent, and a fit and proper person, to operate aircraft for the purposes for which he seeks an air service licence.

Section 2(4). "For the purposes of paragraph (*a*) of subsection (2) of this section, the Board shall not consider the matters in respect of which an air operator's certificate is required, that is to say, the competence of the applicant to secure that aircraft operated by him will be operated safely."

Extract from the Air Navigation Order 1966, Article 4

(3) The Director shall grant to any person applying therefor an air operator's certificate if he is satisfied that that person is competent, having regard in particular to his previous conduct and experience, his equipment, organisation, staffing, maintenance and other arrangements, to secure the safe operation of aircraft of the types specified in the certificate on flights of the description and for the purposes so specified. The certificate may be granted subject to such conditions as the Director thinks fit, and, subject to the provisions of paragraph (4) of this Article, shall remain in force for the period specified in the certificate.

Extract from US Federal Aviation Act of 1958
Sec. 407 (72 Stat. 766, 49 USC 1377)

"(*a*) The Board* is empowered to require annual, monthly, periodical, and special reports from any air carrier; to prescribe the manner and form in which such reports shall be made; and to require from any air carrier specific answers to all questions upon which the Board may deem information to be necessary. Such reports shall be under oath whenever the Board so requires. The Board may also require any air carrier to file with it a true copy of each or any contract, agreement, understanding, or arrangement, between such air carrier and any other carrier or person, in relation to any traffic affected by the provisions of this Act.

---

* The Civil Aeronautics Board

(*b*) Disclosure of Stock Ownership.

……………………………………………………

(*c*) Disclosure of Stock Ownership by Officer or Director.

……………………………………………………

(*d*) The Board shall prescribe the forms of any and all accounts, records, and memoranda to be kept by air carriers, including the accounts, records, and memoranda of the movement of traffic, as well as of the receipts and expenditures of money, and the length of time such accounts, records and memoranda shall be preserved; and it shall be unlawful for air carriers to keep any accounts, records, or memoranda other than those prescribed or approved by the Board: *Provided*, That any air carrier may keep additional accounts, records, or memoranda if they do not impair the integrity of the accounts, records, or memoranda prescribed or approved by the Board and do not constitute an undue financial burden on such air carrier.

(*e*) The Board shall at all times have access to all lands, buildings, and equipment of any carrier and to all accounts, records, and memoranda, including all documents, papers and correspondence, now or hereafter existing, and kept or required to be kept by air carriers; and it may employ special agents or auditors, who shall have authority under the orders of the Board to inspect and examine any and all such lands, buildings, equipment, accounts, records, and memoranda. The provisions of this section shall apply, to the extent found by the Board to be reasonably necessary for the administration of this Act, to persons having control over any air carrier, or affiliated with any air carrier within the meaning of section 5(8) of the Interstate Commerce Act, as amended."

Appendix M

Accident Causes and Prevention

* "Man . . . . must be the focal point of the accident prevention programme."

1. It will be seen from the Safety Review Report that a detailed study has been made of accident *causes* and that a good deal of comment and criticism is rendered on a number of subjects related to accident *prevention*. I should like to offer an independent comment on the question of accident causes and prevention as this subject is germane to any consideration of the operators' safety performance. Since this is a wide subject, the comment is limited to a consideration of some of the broad principles involved.

2. The review of accidents reveals that about 30 per cent. of notifiable accidents are attributable to "airworthiness" causes and about 60 per cent. to "pilot error" ("pilot error" is here taken to mean any failure on the part of the pilot or crew member concerned). One might add that the present state of the art offers no hope of the elimination of either of these two main causes of accidents within the immediate future.

3. In the investigation of accidents one tries to determine the underlying causes as well as the direct and more obvious causes: in this respect there would seem to be a fundamental difference between "airworthiness" accidents and those due to "pilot error". If a particular accident is due to a malfunction of the flap system, the underlying cause might be seen to be a design fault. This is a fully comprehensible situation governed by well-established physical laws. But if any attempt is made to analyse the basic causes of "pilot error" one is confronted by an entirely different situation. Here the problems are often psychological or psycho-physiological in origin and the laws governing human behaviour under these headings have never been defined with precision and perhaps never will be.

4. Dealing first with "airworthiness" accidents, for the reasons above and speaking in the broadest terms, I see no insuperable difficulties in the correct diagnosis of most accident causes and in devising procedures to minimise the chances of repetition. Similarly, looking at aviation as a whole, problems in design, manufacture, maintenance, overhaul and operation are capable of resolution. The engineering practices which have evolved over a long period within the aircraft manufacturing and air transport industries, supplemented by the ARB procedures which monitor the whole system, are basically sound and carry promise of progressive improvement in safety levels.

5. Turning now to accidents due to "pilot error", one enters a highly complex area of investigation containing many intangibles. Nevertheless, there is a very real need to assess the situation as best one may in all the circumstances, to define the problem and to clarify the objectives of a programme of preventive action.

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* Extract from "*MAN the known factor*" by Anchard F. Zeller Ph.D., Research Psychologist Asst. for Medical Services, DTIG.
Aerospace Safety - May 1965.

6. Considered in its simplest terms, the general approach to the problem of "pilot error" would seem to be, first, a recognition of human fallibility and secondly, an attempt to minimise the chances of human error. This is done by good aircraft and flight deck design, by the establishment of set drills and procedures, by high standards of training and by ample opportunities for practice. There are in any case, of course, particularly strong forces at work to prevent errors on the flight deck: a pilot may lose his life, his livelihood or his prestige through a momentary lapse and the responsibility for his passengers and aircraft is not taken lightly.

7. Even so, mistakes do occur; some insignificant, others vital. Most mistakes are corrected before any serious situation develops; the established flight procedure of crosschecking all actions enables this to be done. Occasionally, however, an error will result in an accident: perhaps minor, perhaps disastrous.

8. There are well-established and internationally recognised procedures for the selection, examination, training and checking of pilots. Whilst there is always scope for improvement as the industry develops, these procedures are fundamentally sound, representing as they do the distilled experience and wisdom of many years. At the same time, they have their limitations in dealing with the underlying causes of "pilot error." For this reason I would like to see a "frontal attack" made on this main cause of accidents, involving a deliberate and direct attempt to get to grips with the fundamental issues.

9. Only by a deeper understanding of the complex forces at work in regard to the pilot in his particular environment can we hope to make real progress towards a solution of the "pilot error" accident phenomenon, above and beyond what can be achieved by normal training methods. Accordingly I would favour a change of emphasis in the accident prevention programme towards greater medical and scientific research into this special problem. The complexity of human personality precludes any possibility within the foreseeable future of a complete scientific evaluation but this should not nullify the value of any partial evaluation.

10. I would envisage scientific studies with particular emphasis on flight safety aspects, in a number of fields. Since considerable research has already been undertaken in this country and elsewhere in subjects which are related to the problem, the principle aim would be to collect and process information rather than initiate fresh research, although this latter would doubtless be required in certain instances. Detailed consideration would be necessary to decide a practical course of action, and the most profitable areas of research.

11. It is suggested, therefore, that we look beyond the immediate causes of "pilot error" accidents to the underlying reasons. We need to know the root of the illness rather than the symptoms if we are to effect a cure. I recognise that these are deep waters and that any suggestions in this area can be stillborn through scepticism or complacency. But I have no doubts in my own mind that this is a matter for serious consideration by those in authority.

Suggestions for a Basic Reorganisation of the Total Air Safety Function in the United Kingdom

The Directorate of Aviation Safety

1. It has been agreed generally that a review of the operators' performance in relation to standards of safety automatically involves an examination of the Directorate of Aviation Safety itself. I have dealt with this aspect by considering first the manner in which the Directorate has been meeting its responsibilities and secondly whether any organisational changes are called for.

The manner in which the Directorate has been meeting its responsibilities

2. In the final analysis, the success or failure of the Directorate must be judged on the basis of accident experience which is summarised in the conclusions contained in chapter 4 of the Review Report, as follows:

> A statistical study of accident records has shown that:
>
> (i) the safety levels of all UK public transport operators have improved over the past ten years.
>
> (ii) The safety levels of independent operators as a whole over the ten year period and in each of the two five year periods were significantly lower than those of the combined Corporations.
>
> (iii) The safety levels achieved by UK airlines are probably of the same order as those achieved by the airlines of France and ICAO member states as a whole, but are probably lower than those of United States and Australian airlines.

3. These conclusions indicate that the overall safety level whilst giving no room for complacency equally gives no cause for alarm. Moreover, the improvement shown in recent years may be due largely to the work of the Aviation Safety and General Division of the Board of Trade of which the Directorate of Aviation Safety forms a part. However, the fact that we cannot do better than attain a standard equivalent to the world (ICAO) average is somewhat unsatisfactory and the " significantly lower " safety level of the Independent operators is disturbing. This latter aspect reflects inevitably on the work of the Directorate as it is in the Independent sector that the Directorate applies the greater part of its effort.

4. DSA has freely acknowledged that the Directorate has been unable to meet its responsibilities fully. In particular the Directorate has failed to meet the minimum requirements, established by DSA himself, in regard to the following:

(i) the supervision and inspection of the operators' performance and standards;

(ii) the witnessing of pilot competency checks carried out by operators' check and training captains;

(iii) the inspection of aircraft type rating tests and instrument rating renewal tests conducted by delegated examiners.

5. As examples, in a recent 12-month period, the Flight Operations Inspectorate carried out 279 flight inspections against a minimum target figure

of 456 and the Civil Aviation Flying Unit carried out 116 flight checks, including 41 on initial appointment of examiners, against an average target figure of 370 over the year. The importance of the actual number of checks should not be overemphasised but they do serve as a pointer to the actual achievement of the Directorate. However, the crux of the matter is that the Directorate by its own standards has not been fully effectual.

6. It has been represented to me by DSA and the Commander of the CAFU that shortage of staff has been the cause of the Directorate's failure to fulfil its commitments. I accept that shortage of staff has had a good deal to do with the situation. Since the Establishments Divisions of the Department and the Treasury have primary control over this factor it follows that they must accept a major responsibility for the shortcomings of the Directorate and for the detrimental effect on air safety resulting therefrom.

7. However, apart from the question of staff shortage, certain other factors need to be taken into account:

(i) The total effort of the Directorate is diluted to a considerable extent by the diversion of effort into non-productive channels. This stems mainly from the fact that this Directorate is part of a Government department. Examples are *(a)* the time taken up by staff at all levels in preparing carefully considered answers to frequent Parliamentary questions and *(b)* the time and effort applied by DSA and his senior assistants in preparing and arguing the case for increased staff establishment and higher salary levels with the Establishment branches of the Department and the Treasury over a prolonged period.

(ii) The point is made in the main body of the Review Report that DSA has a dual role, as an official of the Board of Trade and as the Statutory Authority for the Air Operator's Certificate.

This would seem to be an unsatisfactory situation since the pressures to which DSA is inevitably subjected by his superiors in the Board of Trade (and these will include political pressures) will often be at variance with principles and policies which he has established in his capacity as a Statutory Authority.

The responsibilities of the President of the Board of Trade in regard to aviation and in particular to aviation safety are fully recognised. Nevertheless, I believe that an atmosphere of continuous political pressure is inimical to an efficient organisation and to air safety as a whole since it inhibits a normal functioning based primarily on technical considerations.

(iii) The Commander of the CAFU has put forward the argument that, with insufficient staff to meet all the obligations of the Unit, preference had to be given to those duties which had a "time element", in particular the flight testing of candidates for the Commercial Pilot's Licence. The Directorate certainly had good cause for avoiding any criticism from BOAC and BEA of delays in CPL flight tests since, at an earlier stage, the Directorate had successfully resisted an attempt by the Corporations to assume responsibility for these tests. Nevertheless, I am of the opinion that the priorities were wrong and that the all-important flight inspections associated with the AOC should not have taken second place. I consider this to have been a serious error of judgment on the part of the Directorate.

(iv) The history of recent inspections of pilot competency checks and instrument rating renewal tests of one particular operator before and after a fatal accident is disturbing.

Inspections carried out prior to the accident resulted in the company getting a clean bill of health. Yet a very thorough inspection carried out subsequent to the accident resulted in *three* of the training/delegated instrument rating captains being assessed as unsatisfactory to a greater or lesser degree. This suggests that the limited amount of inspection and examination which CAFU has carried out has been insufficient to reveal any weaknesses in an operator's standards of training and checking.

(v) Since the AOC system was introduced in 1961, over 20 per cent of the certificates have been revoked due to a failure on the part of the operators concerned to meet the required safety standards. One is justified in asking whether the inquiries made by the Directorate into the affairs of these operators prior to the issue of the AOC were sufficiently extensive and whether existing methods of inquiry possess adequate safeguards, particularly in regard to the financial implications.

8. Since this statement is critical of the Directorate of Aviation Safety in certain respects, I would wish to add the following comments to maintain a proper perspective on this matter.

(i) The AOC system has been in force for 6 years only, and this period has been a development phase in which the organisation and documentation have been built up.

(ii) The need to procure legal proof to substantiate enforcement action acts as a severe hindrance to the work of the Directorate on many occasions. (If democratic principles are to be observed it is difficult to see how this problem can be resolved. Perhaps a less cautious attitude on the part of the Board of Trade legal department might produce higher safety standards even at the risk of the occasional successful appeal against action taken by DSA).

(iii) I have been favourably impressed by the competency and integrity of the staff with whom I have come in contact.

(iv) Great credit is due to the Director of Aviation Safety for the very real achievements of the Directorate in most difficult circumstances.

Recommended changes in the aviation safety organisation

9. This is an opportune moment to consider whether any modification of the aviation safety organisation is required. I believe this to be so for the following reasons:

(i) The current review of the air operators' safety performance and the civil aviation inquiry which is also in progress both justify comment on this subject;

(ii) The Air Operator's Certificate system has been in force for over six years. Sufficient experience has now been accumulated to judge whether the present organisation adequately meets the requirements of the system;

(iii) An aviation safety organisation must be judged primarily by the results achieved. The accident record in the U.K. cannot be considered satisfactory because of the poor showing of the Independent operators;

(iv) The continuing growth rate of air transport demands an aviation safety organisation which is geared to keep pace with its responsibilities;

(v) The civil air transport industry has reached a milestone in its development with the imminent introduction of both the supersonic Concorde and the Boeing 747. At present only the major operators are concerned in the use of these aircraft but we know from experience that the new wonder aircraft of today become commonplace tomorrow.

These aircraft present a challenge to the industry. They also present a challenge to the aviation safety organisation. No one would wish to underestimate the impact on public opinion of a disaster to a fully loaded Boeing 747 with nearly 400 people on board.

10. The following organisations have a special responsibility in regard to aviation safety:

(i) the Air Registration Board
(ii) the Directorate of Aviation Safety
(iii) the Directorate of Flight Safety
(iv) the Civil Aviation Flying Unit.

11. There is a further organisation which, in my view, has a considerable influence on aviation safety, namely, the Air Transport Licensing Board. Comment on this subject is contained in appendix L.

12. The Directorate of Aviation Safety, the Directorate of Flight Safety and the Civil Aviation Flying Unit are all sections of a government department.

13. The view has been expressed earlier in this paper that the Air Safety organisation would be more efficient if divorced from direct Government control.

14. The Civil Aviation Flying Unit is a cornerstone of the air safety examination and enforcement effort, yet it is responsible not to the Director of Aviation Safety but to the Director of Aerodromes Technical.

15. At present there would seem to be a fragmentation of the overall aviation safety effort between the various organisations which share the responsibility.

16. There is only limited contact between the Civil Aviation Flying Unit and the Flight Operations Inspectorate although both units have direct dealings with the operators and their work is largely complementary.

17. There is hardly any contact between the Air Transport Licensing Board and the other organisations concerned. This is not surprising in view of the particular situation which prevails here and which has been mentioned earlier.

18. I am of the opinion that a unified and co-ordinated aviation safety effort is needed. The existing division of responsibilities does not lend itself to this and I am therefore suggesting a reorganisation which will provide central direction to achieve unity of plan and purpose and economy of effort and finance.

19. A plan of the suggested reorganisation is attached and amplification is made in the following paragraphs.

Civil Aviation Safety Board

20. To have the overall responsibility for civil aviation safety, delegated by Act of Parliament.

Members of the Board

21. The existing Air Registration Board is so constituted that, with some additional members, it would be well suited to assume responsibility for the total air safety function. If air transport in the United Kingdom is to achieve above average safety levels, the motivating forces must come from within. This is why I advocate a Board composed of representatives at the highest level of the industry itself. I would recommend the addition of specialists in the following fields: the practical and detailed analysis and costing of air transport undertakings; the operation of flying training schools.

Air Registration Bureau

22. The present Air Registration Board Executive. The name "Bureau" is primarily to retain the initials ARB.

The Executive would continue to function very much as at present with the following differences:

(i) An "Economic Advisory Service" would be established jointly with the Flight Safety Bureau to work in close co-operation with the Air Transport Licensing Board. The EAS would give firm advice to the ATLB in regard to the financial aspects of both engineering maintenance and flight operations of any operator.

(There is an objection to the establishment of an Economic Advisory Service as suggested here. It could be argued that it would be improper to supply confidential accounts and plans to the EAS since the EAS operates under the direction of the Civil Aviation Safety Board some of whose members will be operating in competition with the air operator who is applying for the air service licence.)

(ii) A Development Branch would be established jointly with the Flight Safety Bureau to give particular attention to developments in both aircraft design and operation.

(iii) A Training and Personnel Licensing Department would be established jointly with the Flight Safety Bureau to deal with the training and licensing of all aircrew and ground engineering staff. This department would be administered by the Flight Safety Bureau.

(iv) An Information Department would be established jointly with the Flight Safety Bureau to collect and process relevant information from all sources. The information would not be confined to flight safety, engineering and operations but would include such subjects as aviation medicine. The information could be made available to the whole of the Industry.

Flight Safety Bureau

23. This would assume the responsibilities of the present Directorate of Aviation Safety with a number of changes. There would be four sub-divisions:

(i) *Training and Personnel Licensing Department*

This would cover *all* aspects of training and licensing including the approval of standards and methods.

(ii) *The Civil Aviation Flying Unit*

Responsible to the Chief Executive of the Flight Safety Bureau for various duties under the heading of "safety" such as flight examinations and tests. The administration of the Unit would be transferred to the Flight Safety Bureau but the Unit would continue to be responsible to the Chief of Telecommunications and the Director of Aerodromes Technical for various functions, possibly on a contract basis. Agreement would need to be reached between the Flight Safety Bureau and the latter officers on priorities and allocation of duties.

The CAFU would require to work in close co-operation with the Training and Personnel Licensing Department to ensure co-ordination and standardisation—precise relationship to be defined.

(iii) *The Flight Operations Inspectorate*

Responsibilities as at present—with an early commitment to bring *all* civil air transport aircraft within its jurisdiction and control (i.e. aircraft of 5,000 lb. maximum all-up-weight or less).

A joint "standardisation unit" to be formed from suitably qualified people from both the CAFU and the Flight Operations Inspectorate (as suggested in Chapter 7).

(iv) *The Private Flying Branch*

To cater for the safety aspects of private flying and gliding.

Finance

24. The budget of the Civil Aviation Safety Board would consist of the following:

(i) existing ARB fees
(ii) existing Personnel Licensing Fees
(iii) new AOC fees payable on application, issue and renewal
(iv) a government contribution to be assessed.

25. The Civil Aviation Safety Board would establish proper communication with other organisations with associated responsibilities.

26. Some of the responsibilities of the present Directorate of Flight Safety would need to be transferred to the Civil Aviation Safety Board: this to be assessed.

27. These suggestions for a reorganisation are restricted to a broad outline of the principles involved and an indication of the practical structure which could be built around these principles. A reorganisation of this magnitude would require the fullest consideration and discussion to resolve the many problems which would be associated with such a change.

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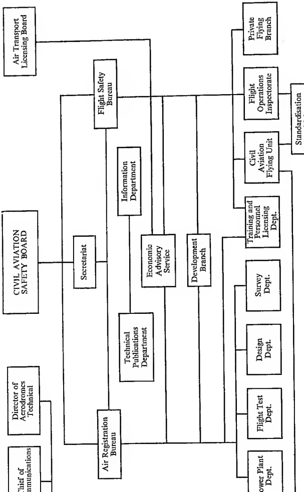
CIVIL AVIATION SAFETY BOARD
Chief of Telecommunications
Director of Aerodromes Technical
Air Transport Licensing Board
Secretariat
Air Registration Bureau
Flight Safety Bureau
Technical Publications Department
Information Department
Economic Advisory Service
Development Branch
Power Plant Dept.
Flight Test Dept.
Design Dept.
Survey Dept.
Training and Personnel Licensing Dept.
Civil Aviation Flying Unit
Flight Operations Inspectorate
Private Flying Branch
Standardisation Unit

BOARD OF TRADE

The safety performance of United Kingdom airline operators

Special review

LONDON
HER MAJESTY'S STATIONERY OFFICE
1968

Members of the Special Review Committee

Mr. W. E. B. Griffiths, CBE	Director of Aviation Safety *Chairman*
Mr. W. Tye, CBE	Air Registration Board
Sir Frederick Brundrett, KCB, KBE	Independent advisers
Captain F. A. Taylor, MVO, DFC	

Miss B. Sowden, *Secretary*

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The Rt. Hon. Anthony Crosland, MP,
President of the Board of Trade

Sir,

We have the honour to submit to you the Report of the Special Review of the Safety Performance of United Kingdom Airline Operators, which was initiated by your predecessor on the 28th June, 1967.

The Report is agreed by the independent Advisers who have added their comments at chapters 10 and 11.

We have the honour to be,
Sir,
Your obedient Servants,

W. E. B. Griffiths,
Director of Aviation Safety.

W. Tye,
The Air Registration Board.

F. Brundrett,
Independent Adviser.

F. A. Taylor,
Independent Adviser.